STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
3100 Port of Benton Blvd • Richland, WA 99354 • (509) 372-7950
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October 25, 2017

17-NWP-149

Mr. Benton J. Harp, Acting Manager
Office of River Protection
United States Department of Energy
PO Box 450, MSIN: H6-60
Richland, Washington 99352

Mr. Mark A. Lindholm, President
Washington River Protection Solutions
PO Box 850, MSIN: H3-21
Richland, Washington 99352

Re: Approval of the Proposed Class 2 Permit Modification 8C.2017.3F to the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, WA7890008967, Part III, Operating Unit Group 3, Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility, WA7890008967

Reference: See page 3

Dear Mr. Harp and Mr. Lindholm:

The Department of Ecology (Ecology) approves your request for a Class 2 Modification, 8C.2017.3F, to the Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility (LERF/ETF) (Reference) in accordance with Washington Administrative Code (WAC) 173-303-830(4)(b)(vi)(B)(I). In accordance with WAC 173-303-840(8)(b), this modification to LERF/ETF, Operating Unit Group 3, is effective November 26, 2017.

With this Class 2 Modification, two container storage areas have been added to the ETF, closure of Load-In Station tanks 59A-TK-109 and 59A-TK-117 has been addressed, and closure of the LERF/ETF has been extended to 2052. Recently installed LERF groundwater monitoring well 299-E26-15 has been incorporated into the Groundwater Monitoring Plan, and the Groundwater Monitoring Plan has been updated to be Hanford-site Dangerous Waste Permit Revision 9 compliant.

This Class 2 Permit Modification is being approved, with changes. The following changes have been incorporated into the modification:

- Clarified language in permit condition III.3.P.1.c to remove text "existing tank systems" as LERF/ETF contains no existing tank systems as defined in WAC 173-303-040.
- Added a definition for flow equalization to the unit-specific conditions.
- Added a permit condition limiting the accumulation of liquid waste stored in the Load-In Station to no greater than the capacity of the containment pit (sump).
- Clarified the methods for transporting containers within Addendum C, Process Information.

- Corrected the Method used for analyzing semivolatile organic compounds to 8270.

- Corrected the Practical Quantitation Limit for n-nitrosodimethylamine to 10 µg/L, for consistency throughout the permit chapter.

The United States Department of Energy (USDOE) held a public comment period regarding the Class 2 Permit Modification request for the Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility from June 26 through September 1, 2017. They held a public meeting on July 26, 2017, at the Richland Public Library at 5:30 pm.

Ecology received 36 public comments from USDOE's comment period. During this modification, we also addressed some comments received during the Hanford Site-wide Permit Revision 9 renewal. We addressed only those comments that were related to the addenda that have been brought to Revision 9 standards: portions of the Part A Form and Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility.

We reviewed the comments and wrote a *Response to Comments* document. The *Response to Comments* document is on the enclosed DVD (Ecology Publication 17-05-009) and on Ecology's website at https://fortress.wa.gov/ecy/publications/SummaryPages/1705009.html.

The permit modification is on the enclosed DVD. A DVD is also at the Hanford Public Information Repositories in Richland, Spokane, and Seattle, Washington, as well as Portland, Oregon. A hard copy is on file at the locations listed below:

Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

United States Department of Energy
Administrative Record
2440 Stevens Center Place
Richland, Washington 99354

Individuals can request copies of the DVD by contacting Ecology's Resource Center at (509) 372-7950.

In accordance with WAC 173-303-830(4)(f)(ii), Ecology's decision to grant or deny a Class 2 Permit Modification request under this section may be appealed under the permit appeal procedures of WAC 173-303-845.

Your Right to Appeal

You have a right to appeal this permit modification to the Pollution Control Hearings Board (PCHB) within 30 days of the date of receipt of this Permit. The appeal process is governed by Chapter 43.21B of the Revised Code of Washington (RCW) and Chapter 371-08 of the WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do all of the following within 30 days of the date of receipt of this Permit:

- File your appeal and a copy of this Permit with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

You must also comply with other applicable requirements in Chapter 43.21B of the RCW and Chapter 371-08 of the WAC.

1. To file your appeal with the Pollution Control Hearings Board

Mail appeal to:	**OR**	**Deliver your appeal in person to:**
Pollution Control Hearings Board PO Box 40903 Olympia, Washington 98504-0903		Pollution Control Hearings Board 1111 Israel Road, Southwest, Suite 301 Tumwater, Washington 98501

2. To serve your appeal on the Department of Ecology

Mail appeal to:	**OR**	**Deliver your appeal in person to:**
Department of Ecology Appeals Processor PO Box 47608 Olympia, Washington 98504-7608		Department of Ecology Appeals Processor 300 Desmond Drive Southeast Lacey, Washington 98503

3. Send a copy of your appeal to:

Stephanie Schleif
Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

If there are any questions regarding this permit modification, please contact Katie Hall, Permit Lead, at katie.hall@ecy.wa.gov or (509) 372-7885 or Annette Carlson, Permit Coordinator, at annette.carlson@ecy.wa.gov or (509) 372-7897.

Sincerely,

Suzanne Dahl
Dangerous Waste Permit Manager
Nuclear Waste Program

kh/jvs
Enclosure

Reference: Letter 17-ECD-0018, received June 21, 2017, from Kevin W. Smith, USDOE-ORP, to Alexandra K. Smith, Ecology, "Submittal of Class 2 Permit Modification Notification to the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility [S-2-8, T-2-8]"

cc: See page 4

cc electronic w/enc:

Dave Bartus, EPA
Laura Buelow, EPA
Mary Beth Burandt, USDOE
Duane Carter, USDOE
Cliff Clark, USDOE
Joe Franco, USDOE
Rob Hastings, USDOE
Lori Huffman, USDOE
Mostafa Kamal, USDOE
Christopher Kemp, USDOE
Tony McKarns, USDOE
Barry Curn, BNI
Sandi Murdock, BNI
Laura Cusack, CHPRC
Moussa Jaraysi, CHPRC
Dru Butler, MSA
Jon Perry, MSA
Ann Shattuck, MSA
Michael Stephenson, PNNL
Lucinda Borneman, WRPS
Debra Alexander, Ecology
Jennifer Cantu, Ecology
Annette Carlson, Ecology
Katie Hall, Ecology
Mandy Jones, Ecology
Stephanie Schleif, Ecology
Ron Skinnarland, Ecology
Nancy Ware, Ecology

cc w/enc, DVD:

Tim Hamlin, EPA
Cliff Clark, USDOE
Lori Huffman, USDOE
Christopher Kemp, USDOE
Barry Curn, BNI
Sandi Murdock, BNI
Matt Johnson, CTUIR
Jack Bell, NPT
Alyssa Buck, Wanapum
Rose Longoria, YN
Susan Leckband, HAB
Ken Niles, ODOE
John Fowler, ACHP
Robin Priddy, BCAA
Donald Redman, USACE
Trevor Fox, USFW
Mike Livingston, WDFW
John Martell, WDOH
John Wiesman, WDOH
Sonia Soelter, WSDA
Allyson Brooks, WSDAHP
Cindy Preston, WSDNR
BNI Correspondence Control
CHPRC Correspondence Control
Environmental Portal
Gonzaga University Foley Central Library
Hanford Facility Operating Record
MSA Correspondence Control
PNNL Correspondence Control
Portland State University Library,
Government Information
University of Washington Suzzallo Library,
Government Publications
USDOE-ORP Correspondence Control
USDOE Public Reading Room, CIC
USDOE-RL Correspondence Control
USEPA Region 10 Hanford Field Office
Correspondence Control
WRPS Correspondence Control

cc w/enc, DVD and hard copy:

NWP Central File
NWP Library
USDOE Administrative Record: Hanford Site-side Permit

DEPARTMENT OF
ECOLOGY
State of Washington

Response to Comments

Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility Class 2 Permit Modification

June 26, 2017, through September 1, 2017

Summary of a public comment period and responses to comments

October 2017
Publication no. 17-05-009

PUBLICATION AND CONTACT INFORMATION

This publication is available on the Department of Ecology's (Ecology) website at https://fortress.wa.gov/ecy/publications/SummaryPages/1705009.html

For more information contact:

Katie Hall, Permit Writer
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, WA 99354

Phone: 509-372-7950
Email: Hanford@ecy.wa.gov

Washington State Department of Ecology - www.ecy.wa.gov

• Headquarters, Lacey	360-407-6000
• Northwest Regional Office, Bellevue	425-649-7000
• Southwest Regional Office, Lacey	360-407-6300
• Central Regional Office, Yakima	509-575-2490
• Eastern Regional Office, Spokane	509-329-3400

Ecology publishes this document to meet the requirements of Washington Administrative Code 173-303-840 (9).

If you need this document in a format for the visually impaired, call the Nuclear Waste Program at 509-372-7950. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Response to Comments

Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility Class 2 Permit Modification

June 26, 2017, through September 1, 2017

Department of Ecology
Nuclear Waste Program
3100 Port of Benton Boulevard
Richland, Washington 99354

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INTRODUCTION

The Washington State Department of Ecology's Nuclear Waste Program (NWP) manages dangerous waste within the state by writing permits to regulate its treatment, storage, and disposal.

When a new permit or a significant modification to an existing permit is proposed, NWP holds a public comment period to allow the public to review the change and provide formal feedback. (See Washington Administrative Code [WAC] 173-303-830 for types of permit changes.)

The Response to Comments is the last step before issuing the final permit, and its purpose is to:

- Specify which provisions, if any, of a permit will become effective upon issuance of the final permit, providing reasons for those changes.
- Describe and document public involvement actions.
- List and respond to all significant comments received during the public comment period and any related public hearings.

This Response to Comments is prepared for:

Comment period:	Class 2 Permit Modification for Hanford's Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility, June 26, 2017, through September 1, 2017
Permit:	*Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Part III, Operating Unit Group 3 (WA7890008967), Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility*
Original issuance date:	January 28, 1998
Draft effective date:	November 26, 2017

To see more information related to the Hanford Site and nuclear waste in Washington, please visit our website: www.ecy.wa.gov/programs/nwp.

REASONS FOR MODIFYING THE PERMIT

The proposed changes are Class 2 permit modifications to the Hanford Facility Dangerous Waste Permit, which regulates the storage, treatment, and disposal of Hanford's dangerous chemical and mixed chemical and radioactive waste. This modification is regarding the Liquid Effluent Retention Facility and the 200 Area Effluent Treatment Facility (LERF/ETF) and it will:

- Add two container storage areas to the permit. These areas were previously used as container storage areas, but were not clearly defined in the permit.
- Extend the date for closure of Load-In Tanks 59A-TK-109 and 59A-TK-117 to the closure of the LERF/ETF.
- Extend closure of the LERF/ETF from 2025 to 2052.

- Update the Groundwater Monitoring Plan and LERF/ETF Characterization and Engineering Report to satisfy permit conditions III.3.R.3.b and III.3.R.3.c, and to become Hanford Dangerous Waste Permit Revision 9 compliant.
- Update the Part A Form to be Hanford Dangerous Waste Permit Revision 9 compliant.
- Remove metric equivalents of measurements throughout the permit chapter.
- Clarify permit condition III.3.P.1.c as LERF/ETF contains no existing tank systems, per WAC 173-303-040 definition of *existing tank systems*.

PUBLIC INVOLVEMENT ACTIONS

Ecology encouraged public comment on the Draft LERF/ETF Permit Modification out for public review during a 60-day public comment period held June 26, 2017, through September 1, 2017.

The following actions were taken to notify the public:

- Mailed a public notice announcing the comment period to 1460 members of the public. Copies of the public notice were distributed to members of the public at Hanford Advisory Board meetings.
- Placed a public announcement legal classified advertisement in the *Tri-City Herald* on June 25, 2017, and again on June 28, 2017, with edited information.
- Emailed a notice announcing the start of the comment period to the Hanford-Info email list, which has 1447 recipients.

The United States Department of Energy, Office of River Protection held a public meeting on July 26, 2017, at 5:30 at the Richland Public Library. One member of the public attended, and no comments were collected.

The Hanford information repositories located in Richland, Spokane, and Seattle, Washington, and Portland, Oregon, received the following documents for public review:

- Public notice
- Transmittal letter
- Draft LERF/ETF Permit Modification

The following public notices for this comment period are in Appendix A of this document:

1. Public notice (focus sheet)
2. Classified advertisement in the *Tri-City Herald*
3. Notice sent to the Hanford-Info email list

LIST OF COMMENTERS

The table below lists the names of organizations or individuals who submitted a comment on the LERF/ETF Permit modification. The comments and responses are in Attachment 1.

Commenter	Organization
Ginn, Judith W.	Citizen
Lowther, Larry	Citizen
Haven, Sylvia	Citizen
Koch, Susan	Citizen
Confederated Tribes and Bands of the Yakama Nation ERWM	Tribal

ATTACHMENT 1: COMMENTS AND RESPONSES

Description of Comments:

Ecology accepted comments from June 26, 2017, through September 1, 2017. This section provides a summary of comments that we received during the public comment period and our responses, as required by RCW 34.05.325(6)(a)(iii).

Comments received during the Hanford Site-wide Permit Revision 9 renewal were also addressed during this modification, but only if the comments related to one of the addenda that has been brought to Revision 9 standards: portions of the Part A Form and Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility.

Comments are grouped by individual and each comment is addressed separately.

Comment from: Judith W. Ginn

I-1-1

I am very concerned that Hanford is not being well cleaned up. It is right on the Columbia River and the Columbia River water goes on to the Pacific to pollute an even larger area. Please ensure that all the nuclear pollution is cleaned up so that it does not get into ground water or river water. I could go on, but won't. Just don't let the clean up stop until it is really and truly done.

Response to: Judith W. Ginn

I-1-1

Ecology is working to ensure that the long-term storage, treatment, and disposal of waste is protective of human health and the environment. Ecology shares your concern for the delays in the cleanup and the state is committed to the protection of human health and the environment.

Comment from: Larry Lowther

I-2-1

I urge you to engage in a thorough clean-up of nuclear waste along the Columbia River around Hanford. We need to make sure that the ground water, the source of drinking water for many people, is perfectly safe. We do not want the Washington State equivalent of Flint, Michigan.

Response to: Larry Lowther

I-2-1

Ecology is working to ensure that the long-term storage, treatment, and disposal of waste is protective of human health and the environment. Stopping any potential nuclear waste from impacting the Columbia River is not within the scope of the LERF/ETF Permit.

Comment from: Sylvia Haven

I-3-1

The clean-up record at Hanford is disgraceful and threatens the citizens of Washington State and the entire country.

Therefore Ecology must NOT grant a new "class 3 permit modification".

There is a lot of cleanup that needs to happen first to protect the waters of the Columbia.

Please get your priorities straight!

Response to: Sylvia Haven

I-3-1

Ecology is working to ensure that the long-term storage, treatment, and disposal of waste is protective of human health and the environment. The scope of this modification is the addition of two container storage areas, updating the Groundwater Monitoring Plan, and addressing closure of two tanks. Ecology classified the modification under the Washington Administrative Code 173-303-830. The State of Washington is committed to the protection of human health and the environment.

Comment from: Susan Koch

I-4-1

I would like a meeting to discuss the length of time this clean up has taken and the proposed extension of clean up. I'm a neighbor that is eager to see this beautiful fenced off area turned into a park in my lifetime.

Response to: Susan Koch

I-4-1

Ecology is working to ensure that the long-term storage, treatment, and disposal of waste is protective of human health and the environment. Ecology shares your concern for the delays in the cleanup and the state is committed to the protection of human health and the environment. To become involved in public meetings and stay current on when these meetings are held, please visit www.hanford.gov/PageAction.cfm/calendar, or visit http://www.ecy.wa.gov/programs/nwp/lists.htm and subscribe to the Hanford-Info email list to have notices emailed to you.

Comment from: Confederated Tribes and Bands of the Yakama Nation ERWM

T-1-1

The proposed modification includes the extension of closure for two tanks associated with the 2025-ED facility. This is allowable; however, the length of time requested is not justifiable. During the public meeting, the Permittee indicated steps have been taken to isolate the tanks, and cited 'financial burdens' as the primary rationale for not closing the tanks at this time. This is not a defensible reason for non-closure of these tanks per WAC 173-303-610(4). Closure of these tanks is not incompatible with the continued operation of the site. YN requests this modification to extend closure these two tanks (59-A-TK-109 and 59A-TK-117) be denied and the Permittee required to comply with WAC 173-303-610(4) within 90 days.

T-1-2

With tank removals, YN asks that total secondary containment area identified on the Part A be verified to ensure compliance with WAC 173-303 and updates made as necessary to design capacities, etc.

T-1-3

YN requests edits to LERF/ETF's Addenda and Glossary to include definition of term flow equalization. Verify and confirm that use of this terminology and process does not result in non-compliant operation of the facilities.

T-1-4

YN requests there is consideration of our comments submitted on the draft Rev 9 permit for the LERF/ETF facilities (e.g., the additional Permit Conditions). YN requests Ecology take this opportunity to make needed additional changes to the Permit Conditions and Addenda through Ecology's issue of the Permit. Our comments are attached for your convenience.

T-1-5

Additionally, although not a consensus product YN requests consideration of the points from Advice # 262 and Addendum 1 COTW/HAB on the draft Permit, Rev 9 for LERF/ETF RCRA TSDs. They are as follows:

Advice # 262: The Board advises Ecology to include in unit-specific Permit conditions requirements for

upgrades and equipment replacement necessary to ensure the safe operation of Hanford RCRA-permitted facilities (e.g., 242-A Evaporator, WTP melters systems, and-so-forth).

Addendum I: Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facilities:

1. Identify in the Permit conditions the criteria for receiving new waste streams at ETF and whether

or not the process includes a public participation process.

2. Include a Permit condition to require hazard identification and hazard mitigation in the Permit.

3. Include a Permit condition requiring the waste acceptance criteria to include identification of

abnormal feed streams.

4. Take into consideration the uncertainty of characterization and volumes of waste streams primarily

coming from WTP and going to ETF, ensure a robust and conservative waste acceptance criterion for

ETF, and ensure that these criteria are reflected in the Permit conditions.

T-1-6

Changes to Permit Condition III.3.R.3: YN requests retention of current Permit condition requirement to update the groundwater-monitoring network with following edits: Maintain and update the groundwater-monitoring network as needed to meet compliance with WAC 173-303-645.

T-1-7

Suggest edits to delete Permit Condition III.3.4.3.a-c if all requirements in the cited report have been met.

T-1-8

Suggest new Permit Condition in III.3.D to state requirements for placement (if that is the intent) of report in the Hanford Facility Operating Record for LERF and 200 Area ETF. If the intent is replacement of the Addendum D, Groundwater Monitoring Plan, or significant changes to the Groundwater Monitoring Plan, this modification should be reclassified as a Class 3 Permit modification.

T-1-9

Section IV - YN requests street location, etc to be specifically identified. Delete proposed; retained

current information or update to reflect U.S. Department of Energy Owner/Operator office location.

T-1-10

Section IX- YN requests clarification of use of the additional new NAICS Codes. It is thought code information in this section is to be specific to the LERF/ETF facility per Ecology publication 030-31 instructions.

T-1-11

Section X-YN requests clarification as to the comment/ information proposed provided regarding the AOP. Delete or include as needed.

T-1-12

Section XIII- YN requests clarification of use of U code. Section XIV-Verify and confirm all

estimated annual quantities of wastes

T-1-13

With additional number of process units (2), YN requests verification and clarification that changes in capacities do not exceed the 25% increase limits due to modifications or additions of tanks or container units [WAC 173-303-830-Appendix I]. Should these changes indicate exceedance of limits, YN requests this proposed modification be reclassified as a Class # 3 modification.

T-1-14

YN requests clarification and verification as to how the schedule of evaporator campaigns will ensure adequate attention is given to operational and maintenance needs for the LERF/ETF facilities.

T-1-15

YN requests confirmation that edits in description of the primary treatment train do not indicate changes in ETF operations (e.g., final pH adjustments and verifications).

T-1-16

YN requests verification and confirmation that with this modification, the secondary containment requirements for each area are sufficient for the volumes of waste to be stored therein for any point in time. Each area must comply with WAC 173-303-630/-640 requirements for secondary containment for containers and/or tanks. YN notes the interconnectedness of all secondary containment systems (e.g., drains to tanks). YN requests denial of this portion of the proposed modification unless each storage/treatment area has its own compliant secondary containment system.

T-1-17

Given the extension of the operations of the WTP facility, YN requests confirmation and verification of integrity of ETF's tanks and ancillary equipment (and secondary containment systems)

T-1-18

Given the extension of the operations of the WTP facility, YN requests confirmation and verification of the operational capabilities and integrity of LERF's liners, dikes, etc over the intended life of the facility given the extension of the operations of the WTP facility.

Confirm and verify all engineering calculations regarding structural integrity of the floor, flood-volume calculations, etc of each of the newly defined container storage and treatment areas.

T-1-19

Table C.4: Edit and confirm dimensions of required secondary containment for all equipment included in Addendum C. Verify details of types of secondary containment for each area are identified on drawings (or elsewhere; identify any referenced documents).

T-1-20

Table C.6: Confirm proposed values are consistent with capacities on the Part A form. Clarify edits to footnote #2-identify what is the operational capacity.

T-1-21

Clarify with more details, the secondary containment in use at the 2025-ED Load-in station and catch basin. Asphalt alone is not sufficient protection of human health and the environment against spills of any type. Verify appropriate secondary containment and inspection criteria are in place for these areas. To ensure secondary containment requirements are maintained, verify permit conditions are in place to ensure no waste volumes will be received which exceed the volume of available space within the containment basin at any one time.

T-1-22

Clarify with more details, control measures for run-on in the Outside Container Storage Area. Verify and confirm that containers in stored in this location do not contain free liquids or wastes which exhibit the characteristics of ignitability or reactivity. Confirm there is no need for protective covering.

T-1-23

Confirm Load-in Station tanks, the surge tank and the secondary treatment train are designed to manage the maximum capacity of any liquids via spills or leaks from the process area, the truck bay, container storage, and Load-in Station areas.

T-1-24

Clarify areas where containers of incompatible wastes are stored.

T-1-25

Clarify proposed text to include the use of 'small water trucks.' See line 28, pg. Addendum C.4 (~pg. 110 of pdf). Is this a change in operations? What waste streams, if any, are being transported?

T-1-26

Clarify use of and location of any 90-day storage pads. (See deleted text on page Addendum C.11).

T-1-27

Clarify with more details, the movement/transport of containers to other TSD facilities or to ERDF.

T-1-28

Confirm with closure of tank system for tanks 59A-TK-109 and -117; all system components will concurrently be managed as dangerous wastes and disposed of as dangerous wastes.

T-1-29

Edit line 6 proposed texts to state: lf any tank system components are found not to meet ...

T-1-30

YN request confirmatory sampling of soils beneath both LERF's liners and ETF's concrete and asphalt (or other coated areas) in addition to visual inspects to verify no releases to the environment. Note: YN disagrees with the leaving of concrete or asphalt surfaces regardless of status of meeting the clean debris surface standards rather than returning the land to original conditions.

T-1-31

Section H.5.2.1: YN requests denial of proposed changes to Addendum H and modification of proposed paragraphs to reflect details of all closure activities and completion of closure activities within 90 days. None of the points made justify length of proposed schedule extension.

T-1-32

Table I.I: Edit to modify inspections of the Uninterruptible Power Supply (UPS) to monthly or bimonthly to ensure support of 242-A Evaporator campaigns/WTP.

T-1-33

Providing the SEPA checklist for public review promotes better understanding of the SEPA process and enhances public knowledge of the unit. As noted in our attached comments, the Yakama Nation believes this proposed permit modification may fall within the definition of a Class 3 Permit Modification. This should include a new SEPA determination available for public review.

T-1-34

Factsheet (likewise the Addendum C) does not explain proposed changes to Permit Condition III.3.R.3 in enough detail. It is unclear as to the intent of change. Is the Permittee merely required to ensure placement of the LERF Engineering Evaluation and Characterization Report in the Hanford Facility Operating Record or does this report replace the Groundwater Monitoring Plan or in some way require updated changes to the Groundwater Monitoring Network. Such changes could result in requirement that this modification be identified as a Class 3 modification. Verify and clarify intent of changes to Condition III.3.R.3 and provide cited report for public review.

T-1-35

The Factsheet (likewise the Addendum C) does not speak to changes resulting in increasing the quantity and updating the basis for the process design capacity and estimated annual quantity of waste. Nor does it provide details of changes to include additional NAICS Codes. YN requests verification and clarification that changes in capacities do not exceed the 25% increase limits due to modifications or additions of tanks or container units [WAC 173-303-830-Appendix I]. Should these changes indicate exceedance of limits, YN requests this proposed modification be reclassified as a Class # 3 modification. YN requests clarification of all changes on the Part A Form to be provided with new Factsheet for Class #3 modification should this be required.

T-1-36

The Factsheet omits an important aspect of the 242-A Evaporator which is that the evaporator is 35 years old and requires continual maintenance. The fact sheet omits the fact that the evaporator has a frequency of equipment failures (pumps fail etc) which have not been carefully tracked and are not carefully planned for in the future. YN requests clarification of frequency of equipment failure and a planned equipment replacement schedule is included within Addendum C and the Permit Conditions to ensure support of 242-A Evaporator campaigns over the lifetime of the facility. YN also requests verification of a schedule for equipment failures for both LERF and ETF.

T-1-37

DNS base on previously submitted SEPA checklists and prior determinations. New permits require new evaluations of current operations.

T-1-38

Edit/revise permit conditions to ensure consistency with DST permit conditions.

T-1-39

Edit all hyper-links to include entire citation referenced (e.g. WAC 173-303-640(7); only WAC 173-303-640 is hyper-linked and not the necessary (7) portion).

T-1-40

Revise Addendum B, Section B.7 Quality Assurance/Quality Control as needed to ensure consistency with Ecology Publication #09-05-007 Guidance for Preparing Waste Sampling and Analysis Documents and QA/QC Requirements at Nuclear Waste Sites.

T-1-41

To ensure secondary containment system capacity requirements (WAC 173-303-630(7) are met; Include/revise a permit condition limiting to 50 percent of floor area of the container storage (22.9 by 8.5 by 0.15 meters) to be occupied by containers at any one time. [See pg. 17 Addendum C, line 1, Section C.3.4.3].

T-1-42

To ensure compliance with Addendum C, Revise Waste Acceptance Permit conditions to identify the criteria for receiving new waste WTP streams at ETF. Take into consideration the uncertainty of characterization and volumes of waste streams primarily coming from WTP and going to ETF, and ensure a robust and conservative waste acceptance criterion for ETF.

T-1-43

Edit and explain in Addendum C Section C.6 the following text: because the 200 Area ETF main treatment train is a Clean Water Act, equivalent treatment unit [40 CFR 268.37(a)] incorporated by reference by WAC 173-303-140, generators are not required to identify underlying hazardous constituents for characteristic wastes pursuant to 40 CFR 268.9, incorporated by reference by WAC 173-303-140, for wastewaters (i.e.,

T-1-44

Include more details in Addendum C (in the appropriate Section(s)) as to what human health or environmental hazards may exist as a result of facilities operations and the controls in place to mitigate or eliminate these concerns

T-1-45

Include more details in Addendum C, Pg. 8, line 3, Section C.2.2 Effluent Treatment Facility Operating Configuration to describe potentially abnormal feed streams which could threaten human health or the environment and how these will be documented.

T-1-46

Include more details in Addendum C, Pg. 10, line 39, Section Verification on what's done to the effluent returned to the LERF, should a treated effluent not meet Discharge Permit or Final Delisting requirements.

T-1-47

Include more details in Addendum C, Pg.11, line 40, Section Concentrate Staging on how the solids are removed to prevent fouling and to protect the thin film dryer, and to maintain concentrate tank capacity.

T-1-48

Include more details in Addendum C, Pg. 36, line 45, Section C.5.2.1.5 Internal and External Pressure Gradients on how the filter extracts the organic compounds ensuring the air is nontoxic.

T-1-49

Include details in Addendum C, Pg.12, line 14, Section Container Handling on safety precautions during manual recapping of filled containers and complies with WAC 173-303-630(5) requirements.

T-1-50

Include details in Addendum C, Pg.15, line 9 on how the 200 Area ETF floor provides secondary containment, and the 200 Area ETF roof and walls protects all containers from exposure to the elements in accordance with the WAC 173-303-630(7),(8),and (9)requirements.

T-1-51

Include details in Addendum C, Pg.15, line 14 on how the absorbents are added, as necessary in accordance with the WAC 173-303-160(4)(b)(i) thru (iv) requirements.

T-1-52

Include details in Addendum C, Pg.15, line 27 on how any reused or reconditioned container will comply with WAC 173-303-160 requirements.

T-1-53

Include citation WAC 173-303-630 as a compliance requirement in Addendum C, Pg 15, line 31, Section C.3.2 Container Management Practices.

T-1-54

Include citation WAC 173-303-630(9) as a compliance requirement in Addendum C, Pg I 7, line 23, Section C.3.4.6: Prevention of lgnitable, Reactive, and Incompatible Wastes.

T-1-55

Include details in Addendum C, Pg.13, Section C.2.5.2 Vessel Off gas System & Pg. 31, Section C.4.6 Air Emissions on how the following is dealt with and how this is in compliance with WAC 173-303-630(11) requirements [note: Section C.6 is very well written]:

a. Degasification; on how purged carbon dioxide is vented to the vessel off gas system (including description of air filters).

b. Thin Film Drying; on how non-condensable vapors and particulates from the spray condenser are exhausted to the vessel off gas system (including description of air filters).

T-1-56

Addendum D monitored dangerous constituents and those monitored in Addendum H are, disconnected. Retain Arsenic, beryllium as constituents of concern in both Addenda.

T-1-57

Edit/revise Addendum D (e.g., D.3.9.6) to remove any reference to use of the Shewhart/CUSUM method and revise with Ecology approved statistical method. (see Appendix A-PNNL-14521-Communications with Ecology; A.1 letter from D. Goswami to M.J.Furman)

T-1-58

Edit Groundwater Permit conditions and Addendum D to ensure compliance with WAC 173-303-645. Addendum D: Pg 5, line 24 Section D.1 states "Inter-well statistical evaluation of LERF groundwater monitoring data has not been performed since 2001." Given that background or baseline values are used to determine whether a RCRA-regulated unit has adversely affected the groundwater quality in the uppermost aquifer beneath the site. And that this is accomplished by testing for statistically significant changes in concentrations of constituents of interest in a downgraident monitoring well relative to baseline levels. And that these baseline levels could be obtained from upgradient (or background) wells, and are referred to as interwell (or between-well) comparisons, it is unclear how required (WAC 173-303-645) statically significant evidence of contamination is obtainable.

T-1-59

Edit Addendum D and include Permit condition(s) to ensure monitoring well maintenance, remediation, and abandonment will involve and be performed in accordance to the following:

o Development of a well inspection plan involving inspection of wells at least once every 5 years; placement of inspection documentation in the Hanford Facility Operating Record).
o Evaluation of wells in accordance with Sections 4.2 through 4.8.3 of Attachment 1 of the HF RCRA
o Provision of written notice to Ecology at least 72 hours before the Permittees remediate (excluding maintenance activities) or abandon any well subject to the HF RCRA Permit.
o Construction of wells pursuant to the HF RCRA Permit in compliance with WAC 173-160.

T-1-60

Addendum D: Edit LERF Groundwater Permit conditions and Addendum D to require redrilling of well 299-E35-2 to depths sufficient for groundwater monitoring sampling requirements (i.e., yield representative samples of groundwater) and drill additional new upgradient and down-gradient wells (see SGW-41072, REV 0, 'The main potential weakness of the well configuration for monitoring would be for constituents to sink and transport below well 299-E26-10 because the well is not fully penetrating & Addendum D, Pg. 11, line 13 Section D.2.4). LERF Groundwater monitoring wells: Well 299-E26-11 [east of LERF] formerly identified as the 'upgradient well,' has been determined to be in a semi-confined aquifer and may not provide representative samples in comparison to the other wells in the monitoring system. It and well 299-E26-10 are projected to be unfit for sampling with the decline of the water table. Furthermore, as groundwater flow rates and directions is westerly when incorporating well 299-E26-11 water-level data and more southerly when data for well 299-E26-11are not incorporated (SGW-41072, REV 0), it has not been demonstrated how the current well monitoring system can be "deemed adequate" and in compliance with WAC 173-303-645(8)(a) without appropriate location of and depth of reliable upgradient and downgraident wells.

T-1-61

Edit Addendum D, as need, for clarity to include:

o Calculation of the rate of unconfined aquifer decline at all groundwater monitoring wells at the LERF point of compliance
o Establishment of the lateral continuity of the unconfined aquifer between groundwater monitoring wells at the LERF point of compliance
o Establishment of the hydrogeologic and groundwater chemistry relationships between groundwater in the Hanford Formation and the uppermost portion of the Elephant Mountain Member (i.e., determine if these represent a single, laterally-continuous aquifer)
o Hydrogeologic testing, well construction, monitoring, etc., as necessary, to achieve the stated objectives of the groundwater-monitoring program.
o Calculation and recording of a "leakage rate" for each basin quarterly (once per every three months). The "leakage rate" calculation will be based on totalizer readings, leachate pump rate, and sump level change. The "leakage rate" will be calculated and recorded in units of gallons/acre/day.
o A description of procedures and protocol followed for quarterly (once per every three months) leachate quantity measurements and "leakage rate" calculations. The procedures and protocol followed will be maintained at the LERF Basin's unit. The description will include a description of equipment and methods for reading and/or calculating volumes.
o Explanation of how records and results of leachate quantity measurements and "leakage rate" calculations will be maintained at the LERF Basin's unit.

T-1-62

From the different geochemistry observed at the various LERF wells, it might be concluded that the wells are not interconnected. As such, Ecology should demonstrate how it was determined that the current groundwater-monitoring network is sufficient to detect releases from LERF. Since this cannot be demonstrated and given the presence of nitrate and sulfates, and the lack of a monitoring well in the confined aquifer (in the basalt), vadose zone monitoring is justified (using omnibus authority WAC 173-303-815(2)(b)(ii)).

Edit Addendum D to ensure satisfaction of performance standards of WAC 173-303-283 that prevent degradation of groundwater quality by to include a sampling and analysis(SAP) describing how the Permittee will evaluate, select, construct, and implement unsaturated monitoring beneath the LERF surface impoundments. This should include description of procedures, structures, or equipment used in the Unsaturated Monitoring Plan; the type(s), numbers, and location of instruments deployed; schedule for constructing or installing any new equipment; description of sampling and analysis; reporting schedules; description of procedures to be followed in the event of a detected release. Consideration should be given to the following alternative environmental monitoring technologies:

o Neutron-Neutron: determination of moisture content, porosity (saturated), and identification of aquitards and lithology
o Tensiometry/Suction Lysimetry: derivation of matrix potential; water content, hydraulic conductivity; pore water samples
o Resistivity Tomography: monitor changes in bulk density;
o Crosshole Radar: moisture distribution, lithology, soil disturbances, buried materials
o Seismic Tomography: porosity, mechanical rock properties, lithology;
o Crosshole Electromagnetic Induction: moisture distribution, identification of shallow contaminant plumes, lithology through steel casing
o High-Resolution Resistivity: moisture, lithology, geologic structure, buried materials, identification of shallow contaminant plumes
o Time Domain Reflectrometry: monitoring flow and transport, and lithology

T-1-63

Edit Addendum D, as need, to reference to D.3.11 when discussing data evaluations not D.3.13.

T-1-64

Edit Addendum F, to include compliance with WAC 173-303-340 requirements.

T-1-65

Edit Addendum F Pg. 6, line 29, Section F.2.1 to specifically cite [as appropriate given the event] WAC 173-303, -145, -350, -360, -610, -645 as the regulatory requirements for management of spills.

T-1-66

Edit Addendum F, Pg 8, line 37, Section F.3 to delete following text: Therefore, the requirements of WAC 173-303-806(4)(a) are not applicable. All RCRA permitted facilities are subject to WAC 173-303-806(4).

T-1-67

Edit Addendum G Training Category Matrix Table, for consistency with Addendum H, to require training in Emergency Response for Sampling Personnel.

T-1-68

Edit Addendum H to include text as needed to provide details [e.g., name of TSD disposal unit] of the management of containers filled with waste as a result of various closure actions for these facilities.

T-1-69

Edit Addendum H to include text as needed to ensure all "disposals" are in a RCRA compliant facility includes meeting LDR requirements of WAC 173-303-140.

T-1-70

Edit Addendum H Pg. 6, line 40-41, Section H.2.3 Closure Standards for Underlying Soils (and elsewhere as needed) to include text that in addition to EPA/240/B-01/003 (EPA/QA R-5), EPA Requirements for Quality Assurance Project41 Plans, as amended, the sampling and analysis plan will be consistent with Ecology Publication #94-111, Guidance for Clean Closure of Dangerous Waste Units and Facilities as amended.

T-1-71

Edit Addendum H, Pg. 5, line 17 Section H.1 to delete "aqueous makeup" as included in uncontaminated equipment and structures, etc.

T-1-72

Edit Addendum H, Pg. 6, line 3 to delete "practical." All ancillary equipment must be flushed and drained. Provide details as to the disposal in a RCRA compliant facility. Edit line 12, to delete reference to partial closure.

T-1-73

Edit Addendum H, Pg. 6, line 22 Section H.2.3 to cite WAC 173-303-140 requirements.

T-1-74

Edit Addendum H, Pg. 6 lines 30-41 Section H.2.3 to include citation WAC 173-303-610(2)(b)(i), or background levels for Hanford soil if background is greater as the closure performance standard for soils/soil/bentonite mixture under ETF. Identify requirement of the Sampling and Analysis Plan to be consistent with Ecology Publication #09-05-007.

T-1-75

Edit Addendum H, Pg. 7 Section H.3.1 General Closure Activities to state closure will comply with WAC 173-303-640 and 173-303-650 requirements as well as 173-303-610.

T-1-76

Revise Addendum H, Pg. 8, lines 45-46-, Section H.3.4.2 [an elsewhere throughout the document as necessary] "Drainage Layer and Secondary Liner" Line 14: Include text to describe management of filled waste containers. Edit Addendum H to include text to describe management of containers filled with waste as a result of various closure actions for these facilities.

T-1-77

Revise Addendum H, Pg. 8, lines 45-46-, Section H.3.4.2 [an elsewhere throughout the document as necessary] "Drainage Layer and Secondary Liner" to also state the sampling and analysis plan will also be consistent with Ecology Publication #09-05-007.

T-1-78

Revise Addendum H, Pg. 9, lines 16-, Section H.3.4.3 [an elsewhere throughout the document as necessary] "Tanks" to also state tanks closures will comply with WAC 173-303-640(8) requirements. Define that all tanks not meeting clean debris performance standards will be macroencapsulated in their entirety, by use of a jacket of inert inorganic materials and disposed of in a RCRA compliant storage facility [e.g. ERDF].

T-1-79

Revise Addendum H, Pg. 10, lines 13-15, Section H.3.4.4 [an elsewhere throughout the document as necessary] "Internal and External Piping and Ancillary Equipment" to state: If it is not possible to meet the clean debris surface standard or the piping or ancillary equipment cannot be inspected, those portions of the piping and ancillary' equipment will be removed, designated, and disposed of according to WAC 173-303-640(8) and 173-303-650 requirements. Delete text, lines 16-19: It is inconsistent with WAC 173-303 Dangerous Waste regulations to require compliance with closure consistent with the 200-IS-1 operable unit decisions; these decisions remain outstanding.

T-1-80

Revise Addendum H, Pg. 11, lines 2-18 Section H.3.4.7 [an elsewhere throughout the document as necessary] "Structures" to state closure steps will include but not be limited to the following activities in accordance to WAC 173-303-610(2)(b)(ii) requirements:

T-1-81

Revise Addendum H, Pg. 11, Section H.3.4.7 [an elsewhere throughout the document as necessary] "Underlying Soils" to require soil sampling under LERF's secondary liner in accordance with WAC 173-303-650(6) and 173-303-610(2)(b)(i) requirements.

T-1-82

Revise Addendum H, Pg. 11, lines 26-37 Section H.3.4.7 [an elsewhere throughout the document as necessary] "Underlying Soils" to require sampling of the concrete floors and bermed areas in accordance with WAC 173-303-640(8) requirements.

T-1-83

Revise Addendum H, Pg. 11, lines 38-40 Section H.3.4.7 [an elsewhere throughout the document as necessary] "Underlying Soils" to require sampling of the soil areas underneath external piping (transfer lines) between the 242-A Evaporator and LERF and 200 Area ETF in accordance with WAC 173-303-640(8) requirements.

T-1-84

Revise Addendum H, Pg. 12, line 4, Section H.5.1 [an elsewhere throughout the document as necessary] Closure of Containers to require Closure in accordance with WAC 173-303-610 & 173-303-630 requirements.

T-1-85

Revise Addendum H, Pg. 12, line 12, Section H.5.2 [an elsewhere throughout the document as necessary] Closure of Tanks to require Closure in accordance with WAC 173-303-610 & 173-303-640 requirements.

T-1-86

Revise Addendum H, Pg. 12, line 18, Section H.5.3 [an elsewhere throughout the document as necessary] Closure of Surface Impoundments to require Closure in accordance with WAC 173-303-610 & l 73-303-650(6)(a) and (6)(b)requirements.

T-1-87

Edit appropriate Sections of Addendum I, to ensure compliance with WAC 173-303-320, -630(6), -640(6), and 650(4) requirements.

T-1-88

Edit Addendum I, Pg. 8, line 5, Section I.1.3 to ensure compliance with WAC 173-303-320(2)(d) requirements with regards to identification of the date and nature of any repairs or remedial actions taken throughout the facilities(LERF & ETF) to be included in the inspection log(s). Edit subsections as needed to also reflect this compliance.

T-1-89

Edit Addendum I to include an Attachment with example of the checklist used by the qualified inspector [reference; Pg 8, line 24, Section I.1.4]

T-1-90

Clarify operating levels stated in Addendum I, Pg 7, line 2; other descriptions have indicated 29.5 million as limit.

T-1-91

Delete following text in Addendum I, Pg. 7, line 22: The WAC 173-303-650 regulations do not require a discussion of piping for surface impoundments. WAC 173-303-650(2)(c) indicates the need to address ancillary equipment which includes piping. Note; It is appropriate to require comprehensive coverage and integrity assessments on piping.

T-1-92

Edit for clarity, Addendum J to ensure compliance with WAC 173-303-340(3) is maintained and consistency with Addendum F.

T-1-93

Revise Addendum J, Pg. 5, Table J.1 to include all cited sections of Permit Attachment 4, Hanford Emergency Management Plan (DOE/RL-94-02) referenced within the Addendum (e.g., Section 5.1 of Permit Attachment 4 is identified on Pg. 11,line 7, Section J.3.4 as a requirement but unlisted in Table J.1). Provide explanations for 'blank footnotes' In Table J.1.

T-1-94

Revise Addendum J, Pg. 10, line 31, Section J.3.2.5.1 to provide explanation of waiver of WAC 173-303-350(3)(b) requirements.

T-1-95

Edit Addendum J, Pg. 11, line 5, Section J.3.4 to require written recovery plan to be developed as an Attachment to Addendum J (i.e., prior to). Suggest use of WAC 173-303-815 omnibus authority as support to ensure compliance with WAC 173-303-360(2)(f) thru (i) and (k)(ix).

T-1-96

Revise Addendum J, Pg. 14, line 17, Section J.6 to include required compliance with WAC 173-303-350(5) in addition to Permit Attachment 4.

Response to: Confederated Tribes and Bands of the Yakama Nation ERWM

T-1-1

Ecology agrees. Financial burdens are not cited in the regulations for requesting an extension to closure. WAC 173-303-610(4) and -610(4)(a)(i) allow the permittee to request an extension to closure if closure will take longer than 90 days to complete. Please refer to Addendum H, Closure Plan, for steps taken to physically isolate the affected tanks. The requirements of WAC 173-303-610(4) are specified in section H.5.2.1 of the permit modification.

T-1-2

No secondary containment quantities are identified on the Part A. Process codes and design capacities in Section XII of the Part A are identified for Load-In Station Tanks 59A-TK-109 and 59A-TK-117. However, isolation of these tanks has already occurred. Design capacities of Tanks 59A-TK-109 and 59A-TK-117 will be decreased to zero once closure of the tanks has been completed.

T-1-3

Ecology agrees. The definition of "flow equalization" will be added to the list of definitions in the unit specific conditions.

T-1-4

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-5

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-6

Groundwater permit condition III.3.R.1 covers the requirements for updating the groundwater monitoring network. After issuance of this modification, a Class 1 prime modification will be submitted to Ecology to update Groundwater conditions under III.3.R.3. The title of the Characterization Report, referenced in permit condition III.3.R.3.c will be modified as part of this modification for consistency.

T-1-7

Conditions III.3.4.3.a-c will be removed in a Class 1 prime permit modification, per WAC 173-303-830(Appendix I)(8) once the current modification is issued and effective.

T-1-8

Ecology has verified all of the changes and the modification qualifies as a Class 2 per WAC 173-303-830(Appendix I)(C). Changes to the number, location, depth, or design of upgradient or downgradient wells of the groundwater monitoring system is a Class 2 per Appendix I, C.1.a.; changes in groundwater sampling or analysis procedures or monitoring schedule is a Class 1 prime per Appendix I, C.2; changes in statistical procedure for determining whether a statistically significant change in groundwater quality between upgradient and downgradient wells has occurred is a Class 1 prime modification per Appendix I, C.3.; changes in indicator parameters, hazardous constituents, or concentration limits as specified in the detection monitoring program is a Class 2 per Appendix I, C.5.

T-1-9

The requirement is for the location to be listed for the facility for which the application is submitted. The Hanford site does not have a specific address. All unit group Part A forms will use this format for the Hanford Site wide Permit, Rev. 9.

T-1-10

Through Rev. 9 permitting guidance, it was determined that all unit groups will display the primary NAICS codes applicable to the Hanford Site.

T-1-11

Other environmental permits listed in the Part A are applicable to the LERF/ETF, including the Air Operating Permit.

T-1-12

The U code is used to denote process "gallons per day" per Ecology publication ECY 030-31, Table 1. Ecology has verified with the Permittee that this information is the most current. The purpose of these changes was to convert quantities from metric to English units. The estimated annual quantity of waste per dangerous waste code was verified and documented in document CHRPC-01900, Rev. 4 for the 200 Area ETF and LERF. The document is maintained in the facility operating record, and is referenced in Addendum C, Process Information, Section C.3.9.

T-1-13

The addition of two container storage areas does not increase the facility's storage capacity, but redefines the existing storage areas. The facility was not expanded to accommodate the additional container storage areas. This type of permit modification is classified as a Class 2 and falls under WAC 173-303-830(Appendix I)(F)(2)(a), Modification of a container unit without increasing the capacity of the unit.

T-1-14

The schedule of 242-A Evaporator campaigns does not determine maintenance needs for LERF/ETF. LERF/ETF uses preventive maintenance to enhance equipment performance and service and pursues system upgrades according to prioritized need.

T-1-15

No changes were proposed to ETF operations, therefore this comment is not within the scope of this permit modification.

T-1-16

For tank capacity and secondary containment volume calculations, please refer to document CHPRC-01900, Rev. 4. Addendum C, Section C.3.9 describes the interconnectedness of the tank systems and refers to CHPRC-01900 which provides calculations for secondary containment capacities and verifies that the secondary containment capacities are adequate. With the exception of the Outdoor Container Storage Area, all other container storage areas are using secondary containment as approved in the permit application.

T-1-17

Changes affecting secondary containment systems and ancillary equipment are not within the scope of this permit modification. DOE is required to conduct the integrity program tank corrosion inspections as required under Section C.4.1.5 of this permit.

T-1-18

Comments regarding liner integrity of the LERF basins are not within the scope of this modification. As part of this modification, Ecology has reviewed the calculations provided in the DOE document CHPRC-01900, referenced in Addendum C, Process Information.

T-1-19

No changes to Table C.4 were requested as part of this modification. Please refer to document CHPRC-01900, Rev. 4, "200 Area Effluent Treatment Facility Resource Conservation and Recovery Act Permit Capacity Calculations," for tank capacity and secondary containment calculations.

T-1-20

The operational capacity was clarified becuase the capacity of the tank listed in Table C.6 was not consistent with the engineering document, Mausshardt, 1995. There is no increase in capacity proposed as part of this modification.

T-1-21

Ecology agrees to add a permit condition stating, "The accumulation of liquid waste stored in the Load-In Station will not be greater than the capacity of the containment pit (sump)." Section C.3.9 describes the Load-In station secondary containment. The 2025-ED Load-In Station utilizes sloped floor to drain liquid to the floor depression, onward to the 59-TK-1 catch basin, and ultimately to the west bay truck pad. The west bay truck pad has a 6-inch high curb to contain the spills and is coated. The east truck pad floor depression is coated. Both pads are sloped to drain liquids to the Load-In Station tank secondary containment pit. Section C.3.9 mentions that the volume of the Load-In Station containment pit is greater than the volume of the largest tanker expected to be received.

T-1-22

Section C.3.9 of Addendum C provides details on secondary containment for containers with free liquids in the Outside Container Storage Area. Run-on to this area is controlled by a surface sloped away from the storage area. See section C.3.9.2 for details on how run-on is controlled in the Outdoor Container Storage Area. A new permit condition will be added to require the permittee to meet the requirements of WAC 173-303-630(7)(b) and -630(7)(c).

T-1-23

A permit condition will be added to require the permittee to not store liquid waste in the Load-In Station in quantities that would exceed the capacity of the containment sump.

T-1-24

Containers of incompatible wastes may be managed in any of the permitted container storage areas and must meet the requirements listed in WAC 173-303-640(9) and as described in Section C.3.9 of Addendum C, Process Information. Section C.3.9.4 will be updated.

T-1-25

Ecology agrees. Text will be changed from "small water truck" to "small tanker truck." Use of a small tanker truck is a clarification, and not a change in operations. The tanker trucks are used to transfer aqueous waste. Refer to Section C, "aqueous waste includes process condensate from the 242-A Evaporator and other aqueous waste generated from onsite remediation and waste management activities."

T-1-26

Ninety-day storage areas are generator activities and not subject to permitting requirements, therefore this text was deleted from the permit.

T-1-27

Ecology agrees. Will add the following text to Addendum C, Section C.3.4: "Containers may be transferred by forklift, approved transport vehicle, or by hand."

T-1-28

The Load-In Station tanks have been isolated and are no longer in use. Final disposition of equipment will be concurrent with closure of the facility. Ecology agrees that both tanks and ancillary equipment will be disposed of as a dangerous waste. Clarification has been made within Section H.5.2.1.

T-1-29

Clean debris surface is only attainable for components that can be visually inspected for evidence of hazardous waste as described in 40 CFR Part 268 and incorporated by reference in WAC 173-303-140. Therefore, this standard may not apply to all components of a tank system, i.e. small diameter piping. See Addendum H, Section H.2 for details on the closure performance standard for the LER/ETF. No change will be made to this text.

T-1-30

No changes are proposed to the closure performance standards, therefore this comment is not within the scope of this permit modification.

T-1-31

Per WAC 173-303-610(4)(a)(i), the extension may be requested if the activities required to close the unit will take longer than ninety days to complete and the Permittee has demonstrated that he has taken and will continue to take all steps to prevent threats to human health and the environment, including compliance with all applicable permit requirements.

T-1-32

This comment is not within the scope of proposed changes in the modification.

T-1-33

On June 19, 2017, the Manager of the U.S. Department of Energy (USDOE) Office of River Protection (ORP) submitted a Class 2 permit modification request for the Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion for the Treatment, Storage and Disposal of Dangerous Waste. ORP proposed several changes to the permit that controls Operating Unit Group 3 Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility. Among them were several Class 1 Prime changes:

- Extension of the closure period
- Changes in the expected year of closure (other permit conditions did not change)
- Changes in groundwater sampling or analysis procedures or monitoring schedules
- Changes in the statistical procedure for determining whether a statistically significant change in groundwater quality between upgradient and downgradient wells has occurred.

ORP also requested several Class 2 modifications:

- Addition of container storage areas that did not result in an increase in capacity of the unit
- Changes in the number, location, depth, or design of upgradient or downgradient wells in the groundwater monitoring system
- Changes in the indicator parameters, hazardous constituents, or concentration limits as specified in the detection monitoring program.

Ecology reviewed each of the proposed modifications against the descriptions in Washington Administrative Code Chapter 173-303 Dangerous Waste Regulations

(WAC 173-303). The review verified the that permit modification met the criteria of a Class 2 change, per Section 173-303-830 Permit Changes (4) Permit modification at the request of the permittee (a) Class 1 modifications, (b) Class 2 modifications, and Appendix I. None of the permit modifications that ORP requested met the definition of a class 3 change in Appendix I; therefore, Ecology does not support the commenter's contention that the permit modifications are Class 3 modifications.

T-1-34

Permit Condition III.3.R.3 requires the Permittees to place the LERF Engineering Evaluation and Characterization Report in the Hanford Facility Operating Record. The proposed Groundwater Monitoring Plan will be located in Addendum D of the Permit. Ecology has verified all of the changes and the modification qualifies as a Class 2 per WAC 173-303-830(Appendix I)(C).

T-1-35

Ecology has verified all of the changes and the modification qualifies as a Class 2 per WAC 173-303-830(Appendix I).

The estimated annual quantity of waste and process design capacity was not increased. The purpose of these changes was to convert quantities from metric to English units. Through Rev. 9 permitting guidance, it was determined that all unit groups will display the primary NAICS codes applicable to the Hanford Site.
The addition of the container storage areas did not result in an increase to the capacity of the unit. Per WAC 173-303-830, Appendix I, 2.a., this is a Class 2 modification.
The extension of the closure period is a Class 1 prime modification, per Appendix I, D.1.b and changes in the expected year of final closure, where other permit conditions are not changed, is also a Class 1 prime per Appendix I, D.1.c.
Changes to the number, location, depth, or design of upgradient or downgradient wells of the groundwater monitoring system is a Class 2 per Appendix I, C.1.a.; Changes in groundwater sampling or analysis procedures or monitoring schedule is a Class 1 prime per Appendix I, C.2; Changes in statistical procedure for determining whether a statistically significant change in groundwater quality between upgradient and downgradient wells has occurred is a Class 1 prime modification per Appendix I, C.3.; Changes in indicator parameters, hazardous constituents, or concentration limits as specified in the detection monitoring program is a Class 2 per Appendix I, C.5.

T-1-36

Equipment failures are not within the scope of this permit modification. Equipment failure cannot be predicted, therefore there is no schedule for verification of equipment failures for LERF/ETF. LERF/ETF uses preventive maintenance to enhance equipment performance and service and pursues system upgrades according to prioritized need.

T-1-37

ORP did not submit a SEPA checklist with this request for a Class 2 permit modification, because the potential adverse environmental impacts of operating the Liquid Effluent Retention Facility and 200 Area EFT had already undergone evaluation. Ecology added the unit to Revision 4 of the Hanford Site Resource Conservation and Recovery Act Dangerous Waste Portion for the Treatment, Storage and Disposal of Dangerous Waste in on January 1, 1998. As stated in Section 2.7 of the SEPA Handbook, SEPA determinations do not have expiration dates.

On April 25, 2012, the Nuclear Waste Program issued another SEPA Determination that included the LERF/200 Area ETF. Ecology made that determination for the then current phase of the SEPA Phased Review of the draft Hanford Site Dangerous Waste Permit Revision 9. For the LERF/200 Area ETF, the proposed action was to continue unit operation. The recent Class 2 permit modification that ORP submitted addressed specific provisions in the dangerous waste permit but did not open all of the provisions in the permit to review. Changes that ORP proposed did not constitute material changes that might have had the potential for significant adverse environmental impacts.

T-1-38

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-39

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-40

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been

modified to meet Rev. 9 standards.

T-1-41

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-42

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-43

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-44

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-45

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been

modified to meet Rev. 9 standards.

T-1-46

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-47

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-48

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-49

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-50

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been

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T-1-51

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T-1-52

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-53

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-54

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-55

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been

modified to meet Rev. 9 standards.

T-1-56

Identification of dangerous constituents for groundwater monitoring was conducted per WAC 173-303-645(4). The constituent selection process for the Groundwater Monitoring Plan in the current modification does not include arsenic and beryllium because these constituents have a distribution coefficient (Kd) value that exceeds 0.8 mL/g. As described in Appendix E of the LERF Engineering Evaluation and Characterization Report, selecting a higher Kd value may result in releases for those constituents going undetected beyond the operating life of the site. Thus, arsenic and beryllium are excluded. Also, Addendum H Section H.3.2 states, "Arsenic and beryllium are excluded because they are present in Hanford soils and may therefore give a false positive sample result."

T-1-57

Ecology agrees. All references to Shewhart/CUSUM method have been removed through updating and reformatting Addendum D.

T-1-58

The Groundwater Monitoring Plan has been revised to incorporate new downgradient groundwater monitoring well 299-E26-15, and updates the groundwater monitoring network to utilize existing wells as upgradient and crossgradient monitoring wells to meet WAC 173-303-645.

T-1-59

Ecology agrees. Attachment 8 of the Hanford Site-wide Permit includes a revised well maintenance and Inspection Plan (HNF-56398, Revision 2, previously BHI-01265, Revision 0).
Attachment 8 of the Hanford Site-wide Permit provides an updated well inspection plan and requires placement of documentation in the Hanford Facility Operating Record.
Attachment 1 of the Hanford Site-wide permit does not contain Sections 4.2 through 4.8.3. However, the revised Groundwater Monitoring Plan meets the requirements of WAC 173-303-645 and -160.
General Permit Condition II.F.2.c includes the requirement to provide written notice at least 72 hours prior to remediation or abandonment of any well. No change will be made to the unit-specific text.
Permit Condition III.3.R.2 requires wells be constructed in compliance with WAC 173-160, as well as Attachment 8 to the Hanford Site-wide Permit.

T-1-60

The LERF Engineering Evaluation and Characterization Report, SGW-41072, provides justification for the well network that is included in the revised Groundwater Monitoring Plan.

T-1-61

Calculation of aquifer decline rate, lateral continuity of the unconfined aquifer, relationships between groundwater in different formations, incorporated information on hydrogeologic testing, well construction, and monitoring have been addressed in the revised Groundwater Monitoring Plan and Engineering Evaluation and Characterization Report.

Leachate levels are monitored at least weekly as described in Addendum C, Section C.5.6.

Descriptions of procedures and protocol to monitor leachate quantity are provided in Addendum C, Section C.5.6.

The Permittee will retain at the Facility, or other Ecology-approved location, records of all monitoring and maintenance records as required by General Permit Condition I.E.10.

T-1-62

The revised Groundwater Monitoring Plan and Engineering Evaluation and Characterization Report address and describe the interconnectedness of the LERF groundwater monitoring wells. An effective groundwater monitoring network has been installed. Therefore, vadose zone monitoring methods do not need to be applied.

T-1-63

Ecology agrees. This change has been made to Addendum D.

T-1-64

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-65

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-66

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-67

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-68

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-69

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-70

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T-1-71

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-72

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T-1-73

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T-1-74

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T-1-75

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T-1-76

Comments received during the Hanford Dangerous Waste Permit Rev. 9 renewal will be addressed within the Rev. 9. Response to Comments Document. Comments received as part of the renewal will not be addressed during modifications to Rev. 8C, unless the comment pertains to Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility, and modified portions of the Part A, which have been modified to meet Rev. 9 standards.

T-1-77

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T-1-78

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T-1-79

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T-1-80

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T-1-81

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T-1-82

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T-1-83

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T-1-84

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T-1-85

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T-1-88

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T-1-89

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T-1-90

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T-1-91

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T-1-92

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APPENDIX A: COPIES OF ALL PUBLIC NOTICES

Public notices for this comment period:

1. Fact Sheet
2. Display advertisement in the *Tri-City Herald*
3. Notice sent to the Hanford-Info email list

Permit change proposed to support Hanford waste management facilities

The U.S. Department of Energy Office of River Protection (ORP) and Washington River Protection Solutions (WRPS) are holding a 60-day public comment period on proposed modifications to the Hanford Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF) Permit. This change is needed to add two container storage areas, address closure of two tanks, as well as to reformat and add a new well to the LERF Groundwater Monitoring Plan.

June 2017 **U.S. Department of Energy – Office of River Protection**

Background

The Hanford Site is located in southeastern Washington State along the Columbia River. The 580-square-mile site was created in 1943 as part of the Manhattan Project to produce plutonium for the nation's defense program. Today, waste management and environmental cleanup are the main missions at Hanford.

The LERF and 200 Area ETF unit is a wastewater storage and treatment system in Hanford's 200 East Area (center of the Hanford Site). The system receives process wastewater from the 242-A Evaporator and other Hanford remediation and waste management activities. The LERF consists of three lined surface impoundments (basins). Wastewater from LERF is pumped to the 200 Area ETF for treatment to remove contaminants.

LERF and ETF operations are subject to the Hanford Dangerous Waste Permit, issued by the Washington State Department of Ecology.

Summary of Proposed Changes

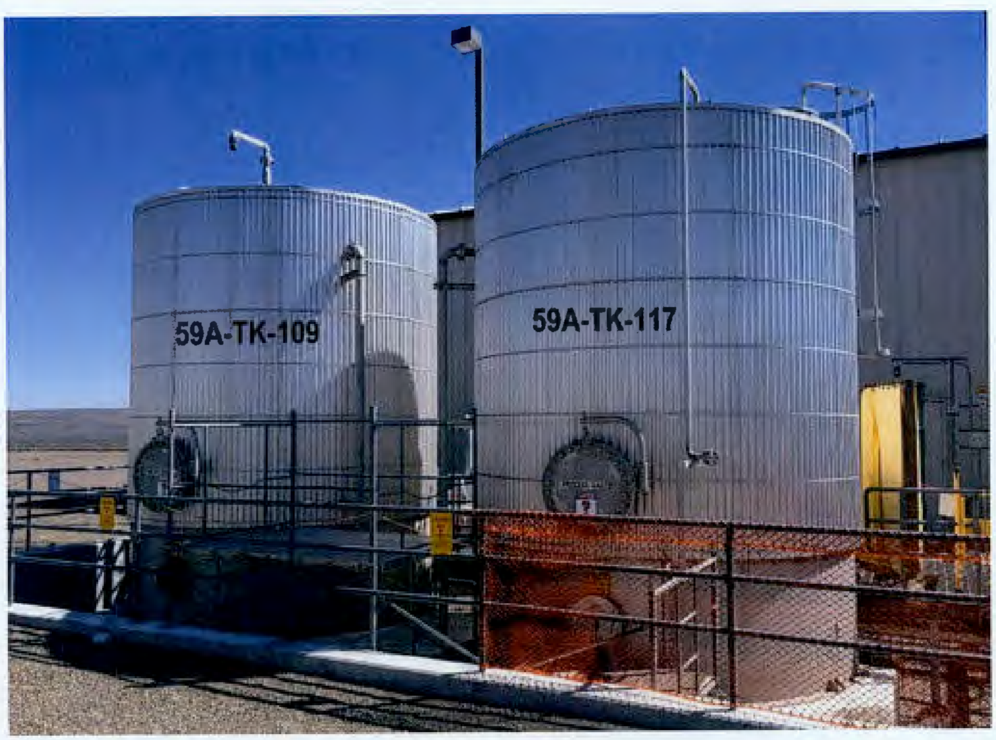
This Class 2 permit modification requests revision of the LERF and 200 Area ETF chapter of the Hanford Permit. The modification request updates existing permit addenda to address the addition of two container storage areas; physical isolation of two tanks located next to Building 2025-ED by September 2017, and the extension of closure for these tanks to the closure of the LERF and 200 Area ETF. The permit modification also proposes reformatting and adding one new well to the LERF Groundwater Monitoring Plan. The addenda included in this modification are the Part A Form, Waste Analysis Plan, Process Information, Groundwater Monitoring Plan, Closure Plan, and Inspection Plan.

We welcome your comments on these proposed changes. The documents are available for review during the comment period on Ecology's Nuclear Waste Program website and at the Hanford Public Information Repositories listed below. For more information, contact Dieter Bohrmann, ORP, at Dieter_G_Bohrmann@orp.doe.gov or (509) 376-9292.

Public Comment Period

We want your feedback on this proposed modification. The public comment period is **June 26 to September 1, 2017.**
A public meeting will be held at 5:30 p.m., Wednesday, July 26 at the Richland Library (955 Northgate Drive).
The meeting will also be accessible via webinar. To register, go to:
https://attendee.gotowebinar.com/register/8280075005970079490 (Webinar ID: 860-590-003)

LERF and 200 Area ETF. The area highlighted in the red circle is part of the proposed permit modification.



Load-In Station Tanks (59A-TK109 and 59A-TK-117) located next to Building 2025-ED.

How to Get Involved

A 60-day public comment period on a proposed Class 2 modification to Part III, Operating Unit 3 of Hanford's Dangerous Waste Permit will run from June 26 through September 1, 2017. A public meeting will be held at 5:30 p.m. July 26 at the Richland Public Library, 955 Northgate Drive in Richland, WA. For more information, see the Hanford Events Calendar at http://www.hanford.gov/pageAction.cfm/calendar?&IndEventID=8237.

Please submit comments electronically by September 1, 2017, on the proposed changes via eComments to: http://wt.ecology.commentinput.com/?id=ereum

Or mail to:

Stephanie Schleif
Washington State Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354

The Permittees' compliance history during the life of the permit being modified is available from the Washington State Department of Ecology. Contact Stephanie Schleif at 509-372-7950.

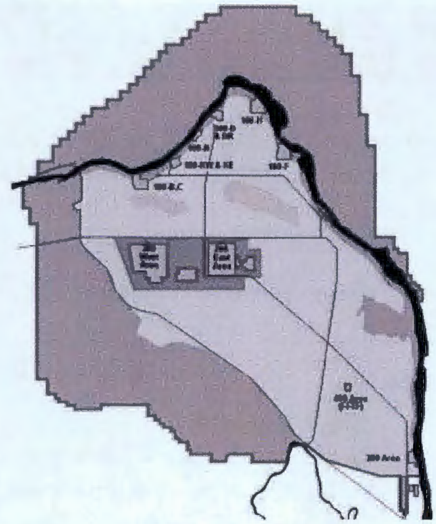
Hanford Public Information Repositories

Copies of the proposed modification and supporting documentation are available for review during the comment period at http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0069670H or www.ecy.wa.gov/programs/nwp/commentperiods.htm. Copies will also be available at the Hanford Public Information Repositories listed below.

Portland State University Government Information Branford Price Millar Library 1875 SW Park Avenue Portland, OR 97207-1151 Attn: Bertrand Robinson (503) 725-4128	**University of Washington** Suzzallo Library Government Publications Dept. Box 352900 Seattle, WA 98195-2900 Attn: Hilary Reinert (206) 543-5597	**U.S. Department of Energy Public Reading Room** Washington State University, Tri-Cities Consolidated Information Ctr., Rm. 101-L 2770 Crimson Way Richland, WA 99352 Attn: Janice Parthree (509) 372-7443	**Gonzaga University** Foley Center Library East 502 Boone Avenue Spokane, WA Attn: John Spencer (509) 313-6110	**Ecology Nuclear Waste Program Resource Center** 3100 Port of Benton Blvd. Richland, WA 93354 Attn: Teresa Booth 509-372-7950
Map: www.pdx.edu/map.html	Map: www.tinyurl.com/m8ebj	Map: www.tricity.wsu.edu/campusmaps/campusmap.pdf	Map: www.tinyurl.com/2c6bpm	Online: http://www.ecy.wa.gov/programs/nwp/commentperiods.htm

Administrative Record and Public Information Repository:
Address: 2440 Stevens Center Place, Room 1101, Richland, WA.
Phone: 509-376-2530 **Web site:** www2.hanford.gov/arpir/

Hanford Public Involvement Opportunity



We want to hear from you on these proposed modifications for the Hanford Permit!

Comment Period: June 26 – September 1, 2017

Public Meeting: 5:30 p.m. July 26 at the Richland Public Library

Class 2 Permit Modification Fact Sheet
U.S. Department of Energy - Office of River Protection
P.O. Box 450
Richland, WA 99352

Melania and Barron settle into life in D.C.

BY DARLENE SUPERVILLE
The Associated Press

WASHINGTON

Two weeks into her new life as a full-time Washingtonian, Melania Trump is staying true to her reputation as more homebody than social butterfly.

Not that she hasn't been busy fulfilling her duties as first lady and first mom.

Her top priority has been settling in 11-year-old son Barron – the first boy in the White House since John F. Kennedy Jr. more than 50 years ago.

Even the smallest details of every recent Barron sighting have drawn interest: his T-shirt reading "The Expert," his grasp on a popular fidget spinner toy as he exited Air Force One, his pivot to take a picture of the Marine One helicopter as the family returned from a Father's Day weekend retreat at Camp David.

Mrs. Trump told "Fox and Friends" this week that she's enjoying White House life so much that she doesn't really miss New York. Barron is "all settled" and "loves it here," she said.

In her role as first lady, Mrs. Trump has played host to her counterpart from Panama for a lunch upstairs in the private quarters of the White House. She also accompanied President Donald Trump to the hospital to visit a Louisiana congressman and others who were shot at baseball practice, and helped plan a picnic for members of Congress on the White House lawn.

She's also preparing to accompany the president to Poland and Germany after the Fourth of July.

Questions remain, though, about what kind and how social a first lady Mrs. Trump will be.

Will she dine out at the city's trendiest restaurants? Pedal up a sweat at SoulCycle spinning classes? Try to go incognito on a Target shopping run?

"I don't know anybody in New York who knows her or ever sees her socially and I suspect that will be the same here," said Sally Quinn, an author and Washington hostess.

Even the president has described his third wife, a 47-year-old former model and native of Slovenia, as more happy at home than working the social scene.

"She would go home at night and didn't even want to go out with people," Trump said of his wife's life in New York. "She was a very private person."

Mrs. Trump and Barron continued to live at Trump Tower after the Jan. 20 inauguration so he could finish the school year in New York. The first lady announced their June 11 move to Washington with a tweet.

"Looking forward to the memories we'll make in our new home! #Movingday," she wrote on a photo of the Washington Monument as seen from a White House window.

Spokeswoman Stephanie Grisham said Mrs. Trump has been and will continue to be an active first lady. But she "is taking some time to get Barron settled into his new home and she continues to be thoughtful and deliberate about her platform." Mrs. Trump said during the campaign that she would work to combat cyberbullying as first lady. She has made no further announcements about her plans.

TY GREENLEES Dayton Daily News

An Air Force Thunderbirds F-16 jet flipped off the end of a runway at Dayton International Airport Friday. Wright-Patterson Air Force Base sent a crash team and heavy rescue crew.

Thunderbird jet flips at air show practice

The Associated Press

DAYTON, OHIO

A technical sergeant has been released from a hospital hours after an Air Force Thunderbirds F-16 left the runway Friday and flipped over after landing during preparation for an air show at Dayton International Airport in Ohio.

The Dayton Daily News reported that Technical Sgt. Kenneth Cordova was released Friday night, but the jet's pilot, Capt. Erik Gonsalves, has not been released as of Saturday afternoon. Both were in good condition.

The Thunderbirds did not perform Saturday at the Vectren Dayton Air Show, and the air crew posted on Twitter late Saturday afternoon that it would not perform Sunday.

The commander in charge of the Thunderbirds has said a safety board will determine the cause of the accident that occurred at the end of an advance flight before the weekend's shows.

FROM PAGE 1B

COLLEGE CASH

tool since it launched about three years ago. Customers can upload a picture of their kid on their personal page, add the year they will enter college and what their dreams are for the future.

Laima Widmer used Fidelity's tool after her husband passed away in March from cancer. People called her friends asking what they could do to help. One friend suggested Widmer open 529 plans for her two teenage daughters and create personalized pages where people could contribute. Links were shared on social media and on a blog Widmer wrote to keep followers updated on her husband's condition. Each of the 529 plans received about $12,000 in gifts. Widmer, who lives near Richmond, Virginia, says the contributions will help ensure her kids will have some money for college. "It was incredible, the generosity," says Widmer, who works at a market research company.

Franklin Templeton Investments, which manages New Jersey's NJBest plan, launched a crowdfunding tool called Spryng in March. Account holders can set a goal on how much money they want to raise. Savers can share their personalized pages and goals on Facebook, Twitter or LinkedIn.

Ascensus College Savings, which runs 529 plans in 18 states and Washington D.C., launched an online platform as part of its Ugift service three years ago. Before that, account holders could only send emails to family and friends asking for contributions. Gift givers could then print out a certificate and send a check. Ascensus says $120 million in contributions came through Ugift last year, a 38 percent increase from 2015.

But crowdfunding doesn't always lead to riches.

Mike Talheim, a school bus driver in Muncie, Indiana, shared a Ugift link on Facebook and Twitter ahead of his 2-year-old daughter's birthday. He even wrote the URL on the party invitations. He received zilch.

But that didn't deter him. He continues to contribute to the 529 plan himself. And he'll try again for gifts during the holidays and for future birthdays.

"If we ever get anything, it will be good for her," Talheim says.

Father buries wrong man after coroner's mistake

The Associated Press

SANTA ANA, CALIF.

Eleven days after laying his son to rest, Frank J. Kerrigan got a call from a friend.

"Your son is alive," he said.

"Bill (Shinker) put my son on the phone," Kerrigan said. "He said 'Hi Dad.' "

Orange County coroner's officials had misidentified the body, the Orange County Register reported Friday.

The mix-up began on May 6 when a man was found dead behind a Verizon store in Fountain Valley, Calif.

Kerrigan, 82, of Wildomar, Calif., said he called the coroner's office and was told the body was that of his son, Frank M. Kerrigan, 57, who is mentally ill and had been living on the street.

When he asked whether he should identify the body, a woman said – apparently incorrectly – that identification had been made through fingerprints.

"When somebody tells me my son is dead, when they have fingerprints, I believe them," Kerrigan said. "If he wasn't identified by fingerprints I would been there in heartbeat."

Frank's sister, 56-year-old Carole Meikle of Silverado, Calif., went to the spot where he died to leave a photo of him, a candle, flowers and rosary beads.

"It was a very difficult situation for me to stand at a pretty disturbing scene. There was blood and dirty blankets," she said.

On May 12, the family held a $20,000 funeral that drew about 50 people from as far away as Las Vegas and Washington state. Frank's brother, John Kerrigan, gave the eulogy.

"We thought we were burying our brother," Meikle said. "Someone else had a beautiful send off. It's horrific."

The body was interred at a cemetery in Orange, Calif., about 150 from where Kerrigan's wife is buried.

Earlier, in the funeral home, the grieving Kerrigan had looked at the man in the casket and touched his hair, convinced he was looking at his son for the last time.

"I didn't know what my dead son was going to look like," he said.

Then came the May 23 phone call from Shinker. Kerrigan's son was standing on the patio.

It was unclear how coroner's officials misidentified the body.

Doug Easton, an attorney hired by Kerrigan, said coroner's officials apparently weren't able to match the corpse's fingerprints through a law enforcement database and instead identified Kerrigan by using an old driver's license photo.

When the family told authorities he was alive, they tried the fingerprints again and on June 1 learned they matched someone else, Meikle said.

Easton said the coroner's office provided the Kerrigan family with a name of that person, but the identification hasn't been independently confirmed. The attorney said the family plans to sue, alleging authorities didn't properly try to identify the body as Kerrigan's son because he is homeless.

COURTESY RICHARD DUVAL IMAGES

Lawrence Vineyard on the Royal Slope in Washington's Frenchman Hills near Othello is proving to be a prime spot for Viognier in the Columbia Valley.

GREAT NORTHWEST WINE

Viognier continues to seduce Washington winemakers

BY ANDY PERDUE AND ERIC DEGERMAN
Great Northwest Wine

Viognier ranks among the most maddening and confounding grapes. It is difficult to grow, and it is equally difficult to make into a balanced and delicious wine.

Yet the grape and its often highly floral aromatics has captured the imagination of some Pacific Northwest winemakers, many of them caught up in the growing interest in Rhône varieties.

Viognier originates in France's northern Rhône Valley, in a region just south of Côte-Rôtie called Condrieu. As recently as 1965, Viognier had dwindled to just a few acres and appeared on the brink of extinction when its fortunes and plantings improved.

It was first planted in Washington in the 1970s, with some of the first Viognier going in at Red Willow Vineyard in the western Yakima Valley.

Today, Viognier remains a darling amid state winemakers, despite its difficulties, and it pairs nicely with scallops, shrimp, spicy Asian fare, creamy cheeses and chicken salad. Last fall, wineries crushed 1,900 tons of Viognier. Here are a few delicious examples of we've tasted in recent weeks..

Armstrong Family Winery 2015 Lawrence Vineyards Viognier, Columbia Valley, $22: The Armstrong family works with the Lawrence family's Corfu Crossing Vineyard and its 2008 planting of Viognier at 1,500 feet elevation along the Royal Slope north of Wahluke Slope. One of Washington's highest vineyards seems to make sense for Viognier as winemakers chase ripeness while maintaining acidity. Tim Armstrong fermented this lot in 40 percent new French oak for 10 months, allowing for aromas and flavors of Bosc pear, lemongrass and orange Creamsicle. Pleasing roundness transitions to a finish of lemony acidity and a shaving of pear skin, setting the table for suggested pairings with ham, turkey or buttery shellfish. (14.8 percent alcohol.)

Martinez & Martinez Winery 2015 Tudor Hills Vineyard Viognier, Yakima Valley, $16: Some of Washington's oldest vineyards serve as neighbors for Mark and Tom Tudor's vines near Grandview, and while they sell to some of the state's largest wineries, here they work Prosser winemaker Andrew Martinez. The nose of lemon meringue pie, nectarine and spearmint include lamb's wool and lanolin. On the palate, it takes a tropical turn with Mandarin orange and honeydew melon, backed by sweet lemon flavors. Enjoy with turkey breast, Tacos Camarones or Pork Pozole. (13.67 percent alcohol.)

Martin-Scott Winery 2015 Viognier, Columbia Valley, $15: Although it's not referenced on the label, Columbia Valley vigneron Mike Scott grows the Viognier on his Needlerock Vineyard overlooking the Columbia River and bottles it at his East Wenatchee estate. The enticing nose offers tropical hints that lead with lychee and are followed by fig, melon and peach. Its flavor profile opens nicely with sweet peach as it picks up ginger and almond on the midpalate. There's a fair bit of residual sugar on the back that's tightened up by orange oil and Bartlett pear skin. Enjoy with Thai or spicy Mexican cuisine. (14.4 percent alcohol.)

William Church Winery 2015 Sara's Vintage Viognier, Columbia Valley, $25: William Church in Woodinville reaches across the Cascades and into the Columbia Basin to create this bright and lively Viognier by using fruit from Gamache and Conner Lee vineyards. There was no wood involved during its four months of fermentation, which explains the clean and tropical aromas with hints of peach and pear, freshly laundered linen and spearmint. That tropical theme continues onto the palate, which is hints at unsweetened Juicy Fruit Gum flavors. A thin sheen of lanolin on the midpalate yields to a pulse of lemon/lime acidity with a scrape of minerality. (14.4 percent alcohol.)

Coyote Canyon Winery 2014 Sweet Louise Late Harvest Viognier/Riesling, Horse Heaven Hills, $22: Justin Michaud's second vintage for Horse Heaven Hills grower Mike Andrews included this tasty dessert wine that's a Coyote Canyon traditional blend of Viognier (62 percent) and Riesling. It finished out at 21 percent residual sugar with a classic ice wine nose of apricot glacéed, fig, poached pear with cinnamon and honey. Those notes come through as flavors, too, wrapped in a texture of maple syrup and capped with a nuttiness that includes a squirt of grapefruit. (11.2 percent alcohol.)

Stottle Winery 2014 Lucille Late Harvest Viognier, Yakima Valley, $21: The aromatics of Viognier continue to lure Josh Stottlemyre into creating a dessert wine from Two Coyote Vineyard. Lovely scents of peach blossom and lavender-infused honey lead to flavors of lychee and apricot stung by finish of honey, beeswax and peach skin. (12.1 percent alcohol.)

Eric Degerman and Andy Perdue run Great Northwest Wine, a news and information company, www.greatnorthwestwine.com

WINE OF THE WEEK

BALBOA WINERY 2016 BLOXOM SLOPE VINEYARD GRÜNER VELTLINER

Appellation: Yakima Valley

Work in the U.S. with this Austrian white grape began with Stephen Reustle in Southern Oregon, and his success with it has inspired others. Walla Walla Valley producers Tom Glase and Tyler Grennan returned to Bloxom Slope near the Yakima Valley community of Moxee, and their latest bottling seems on par with the stellar 2015, which earned a gold medal at last year's Walla Walla Valley Wine Competition. Aromas of creamy lemon, dusty Bosc pear and white peach are reminiscent of a dry Riesling. There's a match on the palate with delicious structure from front to back. Mouthwatering lime pith and Granny Smith apple tartness help describe the finish that doesn't miss any pockets. This earned a gold medal earlier this month at the 34th annual Washington State Wine Competition. Rated "Outstanding!" by Great Northwest Wine. (13.3 percent alc.)

Price: $28

Cases produced: 126

Food pairings: Approach this as you might a dry Riesling or Sauvignon Blanc and reach for a ham sandwich, summertime salads, green vegetables such as asparagus and artichokes, smoked fish or Asian fare that's not overly spicy.

www.balboawinery.com

— GREAT NORTHWEST WINE

FROM PAGE 1B

EAT

For the couple, being mobile means learning the preferences of different audiences. At PNNL, its mostly vegetarian and vegan offerings are a huge hit. Business was slower at Pasco, so they created a Tikka Taco built around marinated chicken. It's a menu staple now.

They're still mastering quantities, as well. Their first day at PNNL, they sold out before the lunch hour started. But having too much food is a problem too.

"The dogs get sick of Indian food," David joked about their pets.

Fast & Curryous is a recent graduate of Mobile Vendor University, a training program at the nonprofit Pasco Specialty Kitchen, that helps mobile food vendors launch and grow businesses.

Marilou Shea, the kitchen's director, called Fast & Curryous a perfect example of the mission to encourage sustainable businesses and to expand the types of cuisines available in the area. From Russian to Somali, the kitchen is open to all would-be entrepreneurs, she said.

The business is young, but the owners hope it will form the foundation for a larger enterprise. They kept the name, Fast & Curryous, simple in order to extend the concept beyond Indian curries to Asian and other varieties.

David would love to add additional trucks and a private kitchen to prepare sauces. Kavita isn't ruling out a physical restaurant in the future.

Follow Fast & Curryous on Facebook.

Wendy Culverwell: 509-582-1514, @WendyCulverwell

From:	^TPA
To:	HANFORD-INFO@LISTSERV.WA.GOV
Subject:	ADVANCE NOTICE: Upcoming comment period on proposed Hanford permit change -- LERF/ETF
Date:	Wednesday, May 24, 2017 2:42:25 PM

This is a message from the U.S. Department of Energy

Notice of Public Comment Period on Proposed Changes to the Hanford LERF and 200 Area ETF Dangerous Waste Permit

The U.S. Department of Energy Office of River Protection is planning a 60-day public comment period to support a proposed modification to the Hanford Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF) permit. This Class 2 modification is needed to add two container storage areas, address closure of two tanks, as well as to reformat and add a new monitoring well to the LERF Groundwater Monitoring Plan.

The public comment period is expected to begin in late June, with a public meeting planned for July.

The proposed modification and supporting documentation will be available during the comment period at http://pdw.hanford.gov/arpir/ as well as at the Hanford Administrative Record and Public Information Repositories located in Richland, Seattle, Spokane and Portland.

A summary fact sheet and details of the public meeting will also be provided when the comment period begins.

Questions? Please contact Dieter Bohrmann, DOE-ORP, at Dieter_G_Bohrmann@orp.doe.gov.

Visit us on the web or social media.

Subscribe or Unsubscribe

From:	^TPA
To:	HANFORD-INFO@LISTSERV.WA.GOV
Subject:	Notice of public comment period on proposed Hanford permit change -- LERF/ETF
Date:	Monday, June 26, 2017 5:16:31 PM
Attachments:	Fact Sheet2 Class 2 LERF-ETF FINAL.pdf

This is a message from the U.S. Department of Energy

The U.S. Department of Energy Office of River Protection (ORP) and Washington River Protection Solutions (WRPS) are holding a 60-day public comment period on proposed modifications to the Hanford Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF) Permit. This Class 2 modification is needed to add two container storage areas, address closure of two tanks, as well as to reformat and add a new monitoring well to the LERF Groundwater Monitoring Plan.

The public comment period runs from **June 26 through September 1, 2017**, with a public meeting scheduled for **July 26 at 5:30 p.m.** at the Richland Public Library (955 Northgate Drive). The meeting will also be accessible via webinar. To register, go to: https://attendee.gotowebinar.com/register/8280075005970079490 (Webinar ID: 860-590-003)

Submit comments electronically (preferred) or by mail by **September 1, 2017** to:

Stephanie Schleif
Washington Department of Ecology
3100 Port of Benton Boulevard
Richland, WA 99354
Electronic comments: http://wt.ecology.commentinput.com/?id=ereum
Phone: (509) 372-7950

The proposed modification and supporting documentation are available for review online at http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0069670H, on Ecology's website, and at Hanford Administrative Record and Public Information Repositories located in Richland, Seattle, Spokane and Portland. Copies can also be reviewed in person at the Hanford Administrative Record Public Information Repository at 2440 Stevens Drive in Richland. The permittee's compliance history during the life of the permit being modified is available from the department of ecology contact person.

For more information, please see the attached fact sheet or contact Dieter Bohrmann, ORP, at Dieter_G_Bohrmann@orp.doe.gov or (509) 376-9292.

LIQUID EFFLUENT RETENTION FACILITY & 200 AREA EFFLUENT TREATMENT FACILITY

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have a "**Last Modification Date**" which represents the last date the portion of the unit has been modified. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Last modification to Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility
October 25, 2017

Addenda	Last Modification Date	Modification Number
Unit-Specific Conditions	10/25/2017	8C.2017.3F
A. Part A Form	10/25/2017	8C.2017.3F
B. Waste Analysis Plan	10/25/2017	8C.2017.3F
C. Process Information	10/25/2017	8C.2017.3F
D. Groundwater Monitoring Plan	10/25/2017	8C.2017.3F
E. Security Requirements	06/30/2011	
F. Preparedness and Prevention	08/25/2016	8C.2016.Q2
G. Personnel Training	06/30/2015	
H. Closure Plan	10/25/2017	8C.2017.3F
I. Inspection Requirements	10/25/2017	8C.2017.3F
J. Contingency Plan	08/25/2016	8C.2016.Q2

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LIQUID EFFLUENT RETENTION FACILITY & 200 AREA EFFLUENT TREATMENT FACILITY PART III, OPERATING UNIT GROUP 3 PERMIT CONDITIONS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/25/2017	8C.2017.3F
08/25/2016	8C.2016.Q2

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PART III, OPERATING UNIT GROUP 3 PERMIT CONDITIONS
LIQUID EFFLUENT RETENTION FACILITY &
200 AREA EFFLUENT TREATMENT FACILITY

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PART III, OPERATING UNIT GROUP 3 PERMIT CONDITIONS LIQUID EFFLUENT RETENTION FACILITY & 200 AREA EFFLUENT TREATMENT FACILITY

UNIT DESCRIPTION

The Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (200 Area ETF) consists of an aqueous waste treatment system that provides treatment, storage integral to the treatment process, and storage of secondary wastes from the treatment process for a variety of aqueous mixed waste. The 200 Area ETF is located in the 200 East Area. Aqueous wastes managed by the 200 Area ETF include process condensate from the LERF and 200 Area ETF and other aqueous waste generated from onsite remediation and waste management activities.

The LERF consists of three lined surface impoundments, or basins. Aqueous waste from LERF is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site (SALDS) north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit Number ST0004500 (Ecology 2014) and 200 Area ETF Delisting (40 Code of Federal Regulations (CFR) 261, Appendix IX, Table 2). Construction of the LERF began in 1990. Waste management operations began at LERF in April 1994. Construction of the 200 Area ETF began in 1992. Waste management operations began at 200 Area ETF in November of 1995.

This Chapter provides unit-specific Permit conditions applicable to the dangerous waste management units for LERF and 200 Area ETF.

LIST OF ADDENDA SPECIFIC TO OPERATING UNIT GROUP 3

Addendum A	Part A Form, dated October 25, 2017
Addendum B	Waste Analysis Plan, dated October 25, 2017
Addendum C	Process Information, dated October 25, 2017
Addendum D	Groundwater Monitoring, dated October 25, 2017
Addendum E	Security Requirements, dated June 30, 2011
Addendum F	Preparedness and Prevention, dated June 30, 2016
Addendum G	Personnel Training, dated June 30, 2015
Addendum H	Closure Plan, dated October 25, 2017
Addendum I	Inspection Requirements, dated October 25, 2017
Addendum J	Contingency Plan, dated June 30, 2016

DEFINITIONS

Flow equalization: Flow equalization is the process by which concentrations of constituents are homogenized through blending of the wastewater in the LERF basins, resulting in a more uniform loading of constituents prior to entering the appropriate treatment train.

State and federal delisting actions: The state delisting action pursuant to Washington Administrative Code (WAC) 173-303-910(3), August 8, 2005, and the federal delisting action appearing in 40 CFR 261, Appendix IX, Table 2 applicable to the United States, Department of Energy, Richland, Washington.

ACRONYMS

LERF and 200 Area ETF	200-Area Liquids Processing Facility

III.3.A COMPLIANCE WITH UNIT-SPECIFIC PERMIT CONDITIONS

III.3.A.1 The Permittees will comply with all Permit Conditions in this Chapter and its Addendums with respect to dangerous waste management and dangerous waste management units in LERF and 200 Area ETF, in addition to requirements in Permit Part I and Part II.

III.3.B GENERAL WASTE MANAGEMENT

III.3.B.1 The Permittees are authorized to accept dangerous and/or mixed waste for treatment in dangerous waste management units that satisfies the waste acceptance criteria in Permit Addendum B according to the waste acceptance procedures in Permit Addendum B. [WAC 173-303-300]

III.3.B.2 The Permittees are authorized to manage dangerous and/or mixed wastes physically present in the dangerous waste management units in LERF and 200 Area ETF as of the effective date of this Permit according to the requirements of Permit Condition III.3.B.1.

III.3.B.3 The Permittees are authorized to treat and/or store dangerous/mixed waste in the dangerous waste management units in LERF and 200 Area ETF according to the following requirements:

III.3.B.3.a The Permittees are authorized to treat, and store as necessary in support of treatment, dangerous waste in the 200 Area ETF tank systems identified in Permit Addendum C, Section C.2, and Section C.4 according to the Permit Conditions of this Chapter.

III.3.B.3.b The Permittees are authorized to store and treat those dangerous and/or mixed waste identified in Permit Addendum C, Section C.3, in containers according to the requirements of this Chapter. All container management activities pursuant to this Permit Condition will take place within the container storage areas or within the 200 Area ETF process area identified in Permit Addendum C, Figures C.2 and C.3.

III.3.B.3.c Treatment in containers authorized by Permit Condition III.3.B.3.b is limited to decanting of free liquids, and addition of sorbents to free liquids. The Permittees will ensure that sorbents are compatible with wastes and the containers. Sorbents will be compliant with the requirements of WAC 173-303-140(4)(b)(iv), incorporated by reference.

III.3.B.3.d The Permittees are authorized to treat aqueous waste in LERF Basins (Basins 42, 43 and 44) subject to the following requirements:

III.3.B.3.d.1 Following treatment in a LERF basin, aqueous wastes must be treated in 200 Area ETF according to Permit Conditions III.3.B.3.a through c.; [40 CFR 268.4(2)(iii), incorporated by reference by WAC 173-303-140]

III.3.B.3.d.2 The Permittees must ensure that for each basin, either supernatant is removed on a flow-through basis, to meet the requirement of 40 CFR 268.4(a)(2)(ii) incorporated by reference by WAC 173-303-140, or incoming waste is shown to not contain solids by either: (1) sampling results showing the waste does not contain detectable solids, or (2) filtering through a 10 micron filter;[WAC 173-303-815(2)(b)(ii)]

III.3.B.4 The Permittees will maintain the physical structure of the LERF and 200 Area ETF as documented in the applicable sections of Permit Addendum C, Section C.2. [WAC 173-303-630(7), WAC 173-303-640(3), WAC 173-303-640(4)]

III.3.B.5 The Permittees are authorized to use treated effluent for recycle/makeup water purposes at the 200 Area ETF as outlined in Permit Addendum C, Section C.2.5.5, and the letters dated August 19, 2005, EPA Region 10 to Keith A. Klein; and August 8, 2005, Department of Ecology to Keith A. Klein. [WAC 173-303-815 (2)(b)(ii)]

III.3.B.6 The Permittees will maintain and operate systems for the 200 Area ETF documented in Permit Addendum C, Section C.2.5 as necessary for proper operation of the 200 Area ETF, compliance with the conditions of this Permit, and protection of human health and the environment. For purposes of this Permit Condition, the Monitor and Control System documented in Permit Addendum C, Section C.2.5.1, is considered to include all indicators, sensors, transducers, actuators and other control devices connected to but remote from the centralized monitor and control system (MCS) computer.

III.3.B.7 The Permittees must complete the following requirements prior to acceptance for treatment in 200 Area ETF aqueous waste streams with listed waste numbers subject to the requirements of the State and Federal delisting: [WAC 173-303-815(2)(b)(ii)]

III.3.B.7.a The Permittees will prepare a written waste processing strategy according to the requirements of the State and Federal Delisting Actions Conditions (1)(a)(ii) and (1)(b), incorporated by reference, and Permit Addendum B, Section B.2.2.2.

III.3.B.7.b The waste processing strategy required by Permit Condition III.3.B.7.a, must document the proposed processing configuration for the 200 Area ETF, operating conditions for each processing unit, and the expected treated effluent characteristics based on the process model and treatability envelope data required by State and Federal Delisting Conditions (1)(a)(ii) and (1)(b).

III.3.B.7.c The written waste processing strategy required by Permit Condition III.3.B.7.a must demonstrate that the projected treated effluent characteristics satisfy the delisting exclusion limits in State and Federal Delisting Condition (5) of the state and federal delisting actions, and the discharge limits of the Discharge Permit Number ST0004500 (Ecology 2014).

III.3.B.7.d The Permittees will place a copy of the written waste processing strategy required by Permit Condition III.3.B.7.a in the Hanford Facility Operating Record, LERF and 200 Area ETF file as part of the documentation of waste streams accepted for management at the 200 Area ETF.

III.3.B.8 Treatment of aqueous waste streams in the 200 Area ETF with listed waste numbers that are subject to the requirements of the state and federal delisting actions must comply with the requirements of State and Federal Delisting Condition (1)(c), incorporated by reference. [WAC 173-303-815 (2)(b)(ii)]

III.3.B.9 The Permittees will manage treated effluent in the final verification tanks according to the requirements of the State and Federal Delisting Conditions (3) and (5), incorporated by reference. [WAC 173-303-815 (2)(b)(ii)]

III.3.B.10 The Permittees will manage treated effluent from the 200 Area ETF according to the requirements of the Discharge Permit Number ST0004500 (Ecology 2014) and State and Federal Delisting Condition (7). [WAC 173-303-815(2)(b)(ii)]

III.3.B.11 The Permittees will ensure compliance with treatment standards (40 CFR 268, incorporated by reference by WAC 173-303-140) applicable to treated effluent prior to discharge to the State Authorized Land Disposal Site (SALDS), the delisting criteria at 40 CFR 261, Appendix IX, Table 2, and the corresponding state-approved delisting (dated August 8, 2005, all incorporated by reference). Sampling and analysis necessary for these demonstrations must meet the corresponding requirements in Permit Addendum B. [WAC 173-303-140, WAC 173-303-815 (2)(b)(ii)]

III.3.C **WASTE ANALYSIS**

III.3.C.1 The Permittees will comply with requirements in Permit Addendum B for sampling and analysis of all dangerous and/or mixed waste required by conditions in this Chapter. [WAC 173-303-300]

III.3.C.2 The Permittees will have an accurate and complete waste profile as described in Permit Addendum B, Section B.2.1.2, for every waste stream accepted for management in LERF and 200 Area ETF dangerous waste management units. [WAC 173-303-380 (1)(a), (b)]

III.3.C.3 The Permittees will place a copy of each waste profile required by Permit Condition III.3.C.2 in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.1.j. [WAC 173-303-380 (1)(a), (b)]

III.3.C.4 The Permittees will make a copy of the waste profile required by Permit Condition III.3.C.2 available upon request. [WAC 173-303-380 (1)(a), (b)]

III.3.C.5 Records and results of waste analysis described in this Permit will be maintained in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.1.b. [WAC 173-303-380 (1)(a), (b)]

III.3.D **RECORDKEEPING AND REPORTING**

III.3.D.1 The Permittees will place the following into the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.1:

III.3.D.1.a Records required by WAC 173-303-380 (1)(k), and -(o) incorporated by reference.

III.3.D.1.b Records and results of waste analysis, waste determinations (as required by Subpart CC) and trial tests required by WAC 173-303-300, General waste analysis, and by 40 CFR §264.1034,§264.1063, §264.1083, §265.1034, §265.1063, §265.1084, §268.4(a), and §268.7; [WAC 173-303-310(2)]

III.3.D.1.c An inspection log, summarizing inspections conducted pursuant to Permit Condition III.3.H.1; [WAC 173-303-380(1)(e)]

III.3.D.1.d Records required by the State and Federal Delisting Condition (6), incorporated by reference; [WAC 173-303-815 (2)(b)(ii)]

III.3.E **SECURITY**

III.3.E.1 The Permittees comply with the Security requirements specific to the LERF and 200 Area ETF in Addendum E and Permit Attachment 3 as required by Permit Condition II.M. [WAC 173-303-310(2)]

III.3.F **PREPAREDNESS AND PREVENTION**

III.3.F.1 The Permittees will comply with the Preparedness and Prevention requirements specific to LERF and 200 Area ETF in Addendum F. [WAC 173-303-340]

III.3.G **CONTINGENCY PLAN**

III.3.G.1 The Permittees will comply with Addendum J, Contingency Plan, in addition to the requirements of Permit Condition II.A when applicable. [WAC 173-303-350]

III.3.H **INSPECTIONS**

III.3.H.1 The Permittees will comply with Addendum I in addition to the requirements of Permit Condition II.X. [WAC 173-303-320]

III.3.I **TRAINING PLAN**

III.3.I.1 The Permittees will include the training requirements described in Addendum G of this Chapter specific to the dangerous waste management units and waste management activities at LERF and 200 Area ETF into the written training plan required by Permit Condition II.C.

III.3.J **GENERAL REQUIREMENTS**

III.3.J.1 The Permittees will comply with the requirements of WAC 173-303-395(1), incorporated by reference, for prevention of reaction of ignitable, reactive, or incompatible wastes.

III.3.K **CLOSURE**

III.3.K.1 The Permittees will close dangerous waste management units in the LERF and 200 Area ETF in accordance with Addendum H, Closure Plan, and Permit Condition II.J. [WAC 173-303-610(3)(a)]

III.3.L **POST CLOSURE – RESERVED**

III.3.M **CRITICAL SYSTEMS – RESERVED**

III.3.N **RESERVED**

III.3.O **CONTAINERS**

III.3.O.1 Container Storage and Treatment Unit Standards

III.3.O.1.a As part of or in addition to the requirements of Permit Condition III.3.B.2, the Permittees will ensure the integrity of container storage secondary containment and the chemically resistant coating described in Addendum C, Section C.3.4.1 as necessary to ensure any spills or releases to secondary containment do not migrate to the underlying concrete or soils.

III.3.O.1.a.1 Include documentation of any damage and subsequent repairs in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.I.

III.3.O.2 Container Management Standards

III.3.O.2.a The Permittees will maintain and manage wastes in accordance with the requirements of Addendum C, Section C.3.2. [WAC 173-303-630(2)]

III.3.O.2.b The Permittees will label containers in accordance with the requirements of Addendum C, Section C.3.2, and Section C.3.3. [WAC 173-303-630(3)]

III.3.O.2.c The Permittees will comply with the requirements for managing wastes in containers in WAC 173-303-630(5), incorporated by reference.

III.3.O.2.d The Permittees will ensure wastes are compatible with containers and with other wastes stored or treated in containers within the 200 Area ETF according to the requirements of Addendum C, Section C.3.1 and C.3.4.6. [WAC 173-303-630(4), WAC 173-303-630(9)]

III.3.O.2.e The Permittees may treat wastes in containers via decanting of free liquids and addition of sorbents. The Permittees may not use addition of sorbents for purposes of changing the treatability group of a waste with respect to the land disposal restriction standards of 40 CFR 268, incorporated by reference by WAC 173-303-140.

III.3.O.2.f The Permittees will remove any accumulated liquids from container storage areas in 200 Area ETF according to the requirements of Addendum C, Section C.3.4.5, to ensure containers are not in contact with free liquids and to prevent overflow of the container storage area secondary containment.

III.3.O.2.g The Permittees will comply with the requirements for air emissions from containers in Addendum C, Section C.6.3.2. [WAC 173-303-692]

III.3.O.2.h The accumulation of liquid waste stored in the 2025-ED Load-In Station will not be greater than the capacity of the containment pit (sump). [WAC 173-303-630(7)(b), WAC 173-303-630(7)(c)]

III.3.O.2.i Containers with free liquids must be placed on spill pallets when placed in the Outdoor Container Storage Area. [WAC 173-303-630]

III.3.P TANK SYSTEMS

III.3.P.1 Tank System Requirements

III.3.P.1.a The Permittees will develop a schedule for conducting integrity assessments (IA). The schedule will meet the requirements of Addendum C, Section C.4.1.5, and consideration of the factors in WAC 173-303-640(2)(e) or WAC 173-303-640(3)(b) as applicable:

III.3.P.1.b The Permittees will maintain a copy of the schedule required by Permit Condition III.3.P.1.a, in the Hanford Facility Operating Record, LERF and 200 Area ETF file, and conduct periodic integrity assessments according to the schedule. The Permittees will document results of integrity assessments conducted according to the IA in the Hanford Facility Operating Record, LERF and 200 Area ETF file.

III.3.P.1.c If a tank system is found to be leaking, or is unfit for use, the Permittees must follow the requirements of WAC 173-303-640(7), incorporated by reference. [WAC 173-303-640(3)(b)]

III.3.P.2 Tank System Operating Requirements

III.3.P.2.a The Permittees will comply with the requirements of WAC 173-303-640(5)(a), incorporated by reference.

III.3.P.2.b The Permittees will comply with the requirements of Addendum C, Section C.4.4.2. [WAC 173-303-640(5)(b)]

III.3.P.2.c The Permittees will comply with the requirements of Addendum C, Section C.4.5. [WAC 173-303-640(5)(d)]

III.3.P.2.d The Permittees will comply with the requirements of WAC 173-303-640(7), incorporated by reference, in response to spills or leaks from tanks systems at 200 Area ETF. [WAC 173-303-640(5)(c)]

III.3.P.2.e The Permittees will ensure that the Waste Processing Strategy required by Permit Condition III.3.B.7.a, provides for the immediate treatment or blending of waste accepted for management at the 200 Area ETF such that the resulting waste or mixture is no longer reactive or ignitable when further managed in 200 Area ETF tank systems. [WAC 173-303-640(9)]

III.3.P.2.f The Permittees will comply with the requirements of WAC 173-303-640(10), incorporated by reference.

III.3.Q SURFACE IMPOUNDMENTS

III.3.Q.1 The Permittees will maintain the three LERF basins according to the requirements of WAC 173-303-650 (2)(f), incorporated by reference.

III.3.Q.2 The Permittees will operate the LERF basins according to the requirements of Addendum C, Section C.5.3, and Addendum I, Section I.1.2.3.1 to prevent over-topping. [WAC 173-303-650 (2)(c)]

III.3.Q.3 The Permittees will develop and maintain, and operate the LERF basins to ensure that any flow of waste into the impoundment can be immediately shut off in the event of overtopping or liner failure. [WAC 173-303-650 (2)(d)]

III.3.Q.4 The Permittees will comply with the requirements of WAC 173-303-650 (2)(g), incorporated by reference.

III.3.Q.5 The Permittees will comply with the requirements of WAC 173-303-650 (4)(b), incorporated by reference.

III.3.Q.6 The Permittees will comply with the requirements of WAC 173-303-650 (4)(c), incorporated by reference. The certification required by this Permit Condition must be provided to Ecology no later than seven calendar days after the date of the certification. A copy of the certification will be placed in the Hanford Facility Operating Record, LERF and 200 Area ETF file required by Permit Condition II.I.1. [WAC 173-303-650 (4)(c)]

III.3.Q.7 The Permittees will comply with the requirements of WAC 173-303-650(5)(b), incorporated by reference, in response to events in WAC 173-303-650(5)(a), incorporated by reference.

III.3.Q.8 The Permittees will comply with the requirements of WAC 173-303-650(5)(d) for any LERF basin that has been removed from service in accordance with Permit Condition III.3.Q.7 that the Permittees will restore to service. [WAC 173-303-650(5)(d)]

III.3.Q.9 The Permittees will close any LERF basin removed from service in accordance with the requirements of Permit Condition III.3.Q.7 or a basin that cannot be repaired or that the Permittees will not to return to service. [WAC 173-303-650(5)(e)]

III.3.Q.10 The Permittees will comply with the requirements of Addendum C, Section C.5.10 with respect to management of ignitable or reactive wastes in the LERF basins. [WAC 173-303-650(7)]

III.3.Q.11 The Permittees can place incompatible wastes and materials in the same LERF basin only if in compliance with the requirements of WAC 173-303-395(1)(b), (c). [WAC 173-303-650(8)]

III.3.Q.12 The Permittees will use the action leakage rate in Addendum C, Section C.5.8, for operation of LERF basins, and comply with the requirements of WAC 173-303-650(10)(b). [WAC 173-303-650(10)]

III.3.Q.13 The Permittees will comply with the requirements of WAC 173-303-650(11), incorporated by reference.

III.3.Q.14 The Permittees will comply with the requirements of 40 CFR 264, Subpart CC, incorporated by reference by WAC 173-303-692.

III.3.R GROUNDWATER

III.3.R.1 The Permittees will comply with the requirements of Addendum D, Groundwater Monitoring Plan. [WAC 173-303-645]

III.3.R.2 All wells constructed pursuant to this Permit will be constructed in compliance with Chapter 173-160 WAC incorporated by reference through WAC 173-303-645 (8)(c).

III.3.R.3 Maintain the Liquid Effluent Retention Facility Engineering Evaluation and Characterization report in the Hanford Facility Operating Record, LERF and 200 Area ETF, which satisfies the requirements in WAC 173-303-806 and -645.

III.3.R.3.a The Permittees will install an additional downgradient monitoring well E-26-15 as identified in Addendum D, Groundwater Monitoring Plan by December, 2016.

III.3.R.3.b Within 60-days of the well installation, the Permittees will submit a Class 2 Permit modification [WAC 173-303-830 Appendix I, C.1.a] to update Addendum D and include the additional monitoring well into the groundwater monitoring network.

III.3.R.3.c Concurrently with the permit modification request, the Permittees will submit a revised "Liquid Effluent Retention Facility Characterization Report" for the additional monitoring well that includes:

1) Well construction in accordance with WAC 173-303-645(8)(c)
2) Well screen placement in the upper aquifer in accordance with WAC 173-303-645(8)(a)
3) Hydrogeologic conditions, stratigraphy and hydraulic conductivity, derived from geologist observations of borehole archive samples, down hole gamma logging, and aquifer slug tests in accordance with WAC 173-303-645(8)(a)(i)(A)
4) Drilling and sampling details in accordance with WAC 173-303-645(8)(d)
5) Borehole corrections (e.g., precision surveys, gyroscopic corrections, and barometric response corrections) to ensure adequate hydraulic understanding considering the very small gradient in accordance with WAC 173-303-645(8)(f)
6) Geochemical comparison of the water quality with other existing wells to ensure anticipated representative conditions in accordance with WAC 173-303-645(8)(a)(ii)
7) Document surface location as required by WAC 173-303-645(6)

III.3.R.3.c.1 Groundwater sample results from the new well (E-26-15) and the existing wells for all constituents in the Addendum D, Groundwater Monitoring Plan for the Liquid Effluent Retention Facility,

III.3.R.3.c.2 Results of evaluating final well development data and drilling logs,

III.3.R.3.c.2.a A well use designation (e.g., upgradient or downgradient).

ADDENDUM A
LIQUID EFFLUENT RETENTION FACILITY & 200 AREA EFFLUENT TREATMENT FACILITY
PART A FORM

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

Addendum A
Part A Form

Date Received	Reviewed by:	Date: 10 17 2017
Month Day Year	Approved by:	Date: 10 25 2017
06 21 2017		

I. This form is submitted to: (place an "X" in the appropriate box)

☒	Request modification to a final status permit (commonly called a "Part B" permit)
☐	Request a change under interim status
☐	Apply for a final status permit. This includes the application for the initial final status permit for a site or for a permit renewal (i.e., a new permit to replace an expiring permit).
☐	Establish interim status because of the wastes newly regulated on: (Date)
	List waste codes:

II. EPA/State ID Number

W	A	7	8	9	0	0	0	8	9	6	7

III. Name of Facility

U.S. Department of Energy – Hanford Facility

IV. Facility Location (Physical address not P.O. Box or Route Number)

A. Street

Refer to Permit Attachment 2, Hanford Facility Permit Legal Description

City or Town	State	ZIP Code
Near Richland	WA	

County Code			County Name
0	0	5	Benton

B. Land Type	C. Geographic Location Latitude (degrees, mins, secs)	Longitude (degrees, mins, secs)	D. Facility Existence Date Month		Day		Year			
F	Refer to TOPO Map (Section XV)		1	1	1	9	1	9	8	0

V. Facility Mailing Address

Street or P.O. Box

P.O. Box 450

City or Town	State	ZIP Code
Richland	WA	99352

VI. Facility contact (Person to be contacted regarding waste activities at facility)		
Name (last)	**(first)**	
Smith	Kevin	
Job Title	**Phone Number (area code and number)**	
Manager	(509) 372-2315	
Contact Address		
Street or P.O. Box		
P.O. Box 450		
City or Town	**State**	**ZIP Code**
Richland	WA	99352

VII. Facility Operator Information		
A. Name		**Phone Number**
U.S. Department of Energy Owner/Operator Washington River Protection Solutions, LLC Co-Operator for LERF & 200 Area ETF		(509) 372-2315 (509) 376-3492
Street or P.O. Box		
P.O. Box 450 P.O. Box 850		
City or Town	**State**	**ZIP Code**
Richland	WA	99352
B. Operator Type	F	
C. Does the name in VII.A reflect a proposed change in operator?	☐ Yes ☒ No	
If yes, provide the scheduled date for the change:	**Month** **Day** **Year**	
D. Is the name listed in VII.A, also the owner? If yes, skip to Section VIII.C.	☐ Yes ☒ No	

VIII. Facility Owner Information		
A. Name	**Phone Number (area code and number)**	
U.S. Department of Energy Owner/Operator	(509) 372-2315	
Street or P.O. Box		
P.O. Box 450		
City or Town	**State**	**ZIP Code**
Richland	WA	99352
B. Owner Type	F	
C. Does the name in VIII.A reflect a proposed change in owner?	☐ Yes ☒ No	
If yes, provide the scheduled date for the change:	**Month** **Day** **Year**	

IX. NAICS Codes (5/6 digit codes)													
A. First							**B. Second**						
5	6	2	2	1	1	Waste Treatment & Disposal	5	6	2	9	1	0	Remediation Services
C. Third							**D. Fourth**						
5	4	1	7	1	2	Research & Development in the Physical, Engineering and Life Sciences	9	2	4	1	1	0	Administration of Air & Water Resource & Solid Waste Management Programs

X. Other Environmental Permits (see instructions)

A. Permit Type	B. Permit Number	C. Description
E	AOP00-05-006	Title V Air Operating Permit. Incorporation of current non-radiological Notice of Construction permits and FF-01 radiological licenses into the AOP may be delayed up to 2 years.
E	DELISTING	ETF Delisting, 70 Federal Register (FR) 44496, dated August 3, 2005
E	TSCA	Toxic Substance Control Act Risk-based Disposal approval Application for Management of Polychlorinated Biphenyl Remediation Waste at the 200 Area Liquid Waste Processing Facilities, dated June 8, 2004
E	OAWT-107	Approval of the Request for Approval of Alternate Reuse Practices for the 200 Area Effluent Treatment Facility (ETF) Treated Effluent, 05-AMCP-0378, dated August 3, 2005
E	ST0004500	WAC 173-216, State Waste Discharge Permit for the 200 Area Effluent Treatment Facility State-Approved Land Disposal Site
E	ST0004511	WAC 173-216, State Waste Discharge Permit Program, Sitewide Permit for Miscellaneous Streams

XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)

Construction of the Liquid Effluent Retention Facility (LERF) began in 1990, and waste management operations began in April 1994. Construction of the 200 Area ETF began in 1992, and waste management operations began in November of 1995. The LERF and 200 Area ETF comprise an aqueous waste (dilute wastewaters) treatment system located in the 200 East Area that provides storage and treatment for a variety of aqueous mixed waste.

The aqueous waste streams are contaminated with radionuclides, heavy metals, and/or organic constituents. For example, the process condensate from the 242-A Evaporator is a treatment residue; and the primary chemicals that carry over from dewatering process are ammonia and acetone. Leachate from mixed waste landfills is composed of storm water that has leached through a Subtitle C landfill, and could contain a small amount of radionuclides and chemical constituents leached from land disposal restrictions (LDR) compliant wastes. Purgewater is composed of >99% groundwater that may be contaminated with radionuclides and dangerous waste from past-practice spills or releases. This aqueous waste includes process condensate from the 242-A Evaporator and other aqueous waste generated from onsite remediation and waste management activities. As such, Section XIV contains the same waste numbers as the 242-A Evaporator.

S04 and T02 - Surface Impoundment Storage and Treatment

Three lined surface impoundments (LERF Basins 42, 43, and 44) are used to store and treat aqueous waste. Aqueous waste in LERF is treated by pH and flow equalization. Operations of the LERF basins qualified for the surface impoundment treatment exemption from the LDR in accordance with 40 CFR 268.4, incorporated by reference by WAC 173-303-140 (reference Addendum B, Waste Analysis Plan). The aqueous waste from LERF is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit (ST0004500) and the 200 Area Final Delisting (40 CFR 261, Appendix IX, Table 2).

S01 and T04 - Container Storage and Treatment

Five container storage and treatment DWMUs are located at the 200 Area ETF. Containers in these areas can be moved between DWMUs. The primary treatment in containers is decanting and the use of absorbents to stabilize free liquids in sludge drained from treatment tanks. Once containers are full, the containers are moved to the 2025-E Container Storage Area, the Outside Container Storage Area, sent to another TSD facility, or Environmental Restoration Disposal Facility (ERDF), as appropriate.

The container design capacity 39,000 gallons is an empirical number based on the equivalent of storing 709, 55-gallon drums within the five-container storage areas. The treatment capacity 5,000 gallons is an empirical number based on maximum anticipated treatment. The five container storage and treatment areas are:

XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)

- 2025-E Process Area. The waste primarily consists of containers that function as part of the waste management process. Waste streams are accumulated into DOT approved containers near a specific operation within the 2025-E Process Area. The containers primarily store waste generated from maintenance and operations activities. Treatment activities include decanting and the use of absorbents for liquid stabilization. Another function of the waste management process is to store aqueous waste containers from other Hanford Site sources in the 2025-E Process Area and transfer the waste to the 200 Area ETF tanks for processing. Once the Process Area containers are full, the containers are moved to the 2025-E Container Storage Area, the Outside Container Storage Area, another TSD facility, or ERDF.
- 2025-E Container Storage Area. The containerized waste primarily consists of dry powder treatment residues, aqueous wastes received for treatment, and waste generated from maintenance and operations activities. Treatment activities in this area include decanting and the use of absorbents for liquid stabilization.
- 2025-E Truck Bay. This area is used to store containers being moved between the 2025-E Process Area, 2025-E Container Storage Area, and Outside Container Storage Area. The containerized waste primarily consists of dry powder treatment residues, aqueous wastes received for treatment, and waste generated from maintenance and operations activities. Treatment activities in this area include decanting and the use of absorbents for liquid stabilization. However, container storage and treatment is limited because of the limited space available in the 2025-E Truck Bay.
- Outside Container Storage Area. The containerized waste primarily consists of dry powder treatment residues, and waste generated from maintenance and operations activities. Treatment activities in this area include the use of absorbents for liquid stabilization.
- 2025-ED Load-In Station. This area is primarily used to store waste generated from maintenance and operations activities, aqueous waste in tanker trucks and other containers (such as drums, or totes) until the waste is transferred into the Load-In Station tank, surge tank, or directly to LERF. Treatment activities in this area include decanting and the use of absorbents for liquid stabilization.

S02 and T01 – Tank Storage and Treatment

The list provided below identifies the tank storage and treatment DWMUs identified in Section XII.C. Aqueous waste is treated and stored in the 2025-E Process Area in a series of tank systems. Additionally, three tanks are associated with the 2025-ED Load-In Station. The structural design capacity is based on the tank dimensions. Addendum C, Section C.4 contains additional information on the following tanks.

1. 20B-TK-1, Sump Tank 1
2. 20B-TK-2, Sump Tank 2
3. 59A-TK-1, Load-In Station Tank
4. 59A-TK-109, Load-In Station Tank (physically isolated from service; refer to Addendum H, Closure Plan)
5. 59A-TK-117, Load-In Station Tank (physically isolated from service; refer to Addendum H, Closure Plan)
6. 60A-TK-1, Surge Tank
7. 60C-TK-1, pH Adjust Tank
8. 60C-TK-2, Effluent pH Adjust Tank
9. 60F-TK-1, 1st RO Feed Tank
10. 60F-TK-2, 2nd RO Feed Tank
11. 60H-TK-1A, Verification Tank
12. 60H-TK-1B, Verification Tank
13. 60H-TK-1C, Verification Tank
14. 60I-EV-1, Evaporator Vapor Body Vessel
15. 60I-TK-1A, Secondary Waste Receiving Tank
16. 60I-TK-1B, Secondary Waste Receiving Tank
17. 60I-TK-2, Distillate Flash Tank
18. 60J-TK-1A, Concentrate Tank
19. 60J-TK-1B, Concentrate Tank

NAICS Codes

NAICS Codes listed in Section IX.B – IX.D apply to the Hanford Facility and not to this unit.

EXAMPLE FOR COMPLETING ITEMS XII and XIII (shown in lines numbered X-1, X-2, and X-3 below): A facility has two storage tanks that hold 1200 gallons and 400 gallons respectively. There is also treatment in tanks at 20 gallons/hr. Finally, a one-quarter acre area that is two meters deep will undergo in situ *vitrification.*

Section XII. Process Codes and Design Capacities									Section XIII. Other Process Codes									
Line Number		A. Process Codes (enter code)			B. Process Design Capacity 1. Amount	B. Process Design Capacity 2. Unit of Measure (enter code)	C. Process Total Number of Units		Line Number		A. Process Codes (enter code)			B. Process Design Capacity 1. Amount	B. Process Design Capacity 2. Unit of Measure (enter code)	C. Process Total Number of Units	D. Process Description
X	1	S	0	2	1,600	G	002		X	1	T	0	4	700	C	001	In situ vitrification
X	2	T	0	3	20	E	001										
X	3	T	0	4	700	C	001										
	1	S	0	4	23,400,000	G	003			1	T	0	4	5,000	U	005	container treatment
	2	T	0	2	23,400,000	U	003			2							
	3	S	0	2	2,630,000	G	019			3							
	4	T	0	1	216,000	U	019			4							
	5	S	0	1	39,000	G	005			5							
	6	T	0	4	5,000	U	005			6							
	7									7							
	8									8							
	9									9							
1	0								1	0							
1	1								1	1							
1	2								1	2							
1	3								1	3							
1	4								1	4							
1	5								1	5							
1	6								1	6							
1	7								1	7							
1	8								1	8							
1	9								1	9							
2	0								2	0							
2	1								2	1							
2	2								2	2							
2	3								2	3							
2	4								2	4							
2	5								2	5							

XIV. Description of Dangerous Wastes

Example for completing this section: A facility will receive three non-listed wastes, then store and treat them on-site. Two wastes are corrosive only, with the facility receiving and storing the wastes in containers. There will be about 200 pounds per year of each of these two wastes, which will be neutralized in a tank. The other waste is corrosive and ignitable and will be neutralized then blended into hazardous waste fuel. There will be about 100 pounds per year of that waste, which will be received in bulk and put into tanks.

Line Number	A. Dangerous Waste No.				B. Estimated Annual Quantity of Waste	C. Unit of Measure	D. Processes									
							(1) Process Codes									(2) Process Description [If a code is not entered in D (1)]
X 1	D	0	0	2	400	P	S	0	1	T	0	1				
X 2	D	0	0	1	100	P	S	0	2	T	0	1				
X 3	D	0	0	2												**Included with above**
1	D	0	0	1	337,000,000	P	S	0	4	T	0	2				Surface Impoundment Storage & Treatment
2	D	0	0	2												Included with above
3	D	0	0	3												Included with above
4	D	0	0	4												Included with above
5	D	0	0	5												Included with above
6	D	0	0	6												Included with above
7	D	0	0	7												Included with above
8	D	0	0	8												Included with above
9	D	0	0	9												Included with above
10	D	0	1	0												Included with above
11	D	0	1	1												Included with above
12	D	0	1	8												Included with above
13	D	0	1	9												Included with above
14	D	0	2	2												Included with above
15	D	0	2	8												Included with above
16	D	0	2	9												Included with above
17	D	0	3	0												Included with above
18	D	0	3	3												Included with above
19	D	0	3	4												Included with above
20	D	0	3	5												Included with above
21	D	0	3	6												Included with above
22	D	0	3	8												Included with above
23	D	0	3	9												Included with above
24	D	0	4	0												Included with above
25	D	0	4	1												Included with above

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)				B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
							(1) Process Codes (enter)									(2) Process Description [If a code is not entered in D (1)]
26	D	0	4	3												Included with above
27	F	0	0	1												Included with above
28	F	0	0	2												Included with above
29	F	0	0	3												Included with above
30	F	0	0	4												Included with above
31	F	0	0	5												Included with above
32	F	0	3	9												Included with above
33	W	T	0	1												Included with above
34	W	T	0	2												Included with above
35	U	2	1	0												Included with above
36	D	0	0	1	257,300,000	P	S	0	2	T	0	1				Tank Storage & Treatment
37	D	0	0	2												Included with above
38	D	0	0	3												Included with above
39	D	0	0	4												Included with above
40	D	0	0	5												Included with above
41	D	0	0	6												Included with above
42	D	0	0	7												Included with above
43	D	0	0	8												Included with above
44	D	0	0	9												Included with above
45	D	0	1	0												Included with above
46	D	0	1	1												Included with above
47	D	0	1	8												Included with above
48	D	0	1	9												Included with above
49	D	0	2	2												Included with above
50	D	0	2	8												Included with above
51	D	0	2	9												Included with above
52	D	0	3	0												Included with above
53	D	0	3	3												Included with above
54	D	0	3	4												Included with above
55	D	0	3	5												Included with above
56	D	0	3	6												Included with above

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)				B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
							(1) Process Codes (enter)									(2) Process Description [If a code is not entered in D (1)]
57	D	0	3	8												Included with above
58	D	0	3	9												Included with above
59	D	0	4	0												Included with above
60	D	0	4	1												Included with above
61	D	0	4	3												Included with above
62	F	0	0	1												Included with above
63	F	0	0	2												Included with above
64	F	0	0	3												Included with above
65	F	0	0	4												Included with above
66	F	0	0	5												Included with above
67	F	0	3	9												Included with above
68	W	T	0	1												Included with above
69	W	T	0	2												Included with above
70	U	2	1	0												Included with above
71	D	0	0	1	340,000	P	S	0	1							Container Storage Includes Debris
72	D	0	0	2												Included with above
73	D	0	0	3												Included with above
74	D	0	0	4												Included with above
75	D	0	0	5												Included with above
76	D	0	0	6												Included with above
77	D	0	0	7												Included with above
78	D	0	0	8												Included with above
79	D	0	0	9												Included with above
80	D	0	1	0												Included with above
81	D	0	I	1												Included with above
82	D	0	1	8												Included with above
83	D	0	1	9												Included with above
84	D	0	2	2												Included with above
85	D	0	2	8												Included with above
86	D	0	2	9												Included with above
87	D	0	3	0												Included with above

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)				B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process (1) Process Codes (enter)									D. Process (2) Process Description [If a code is not entered in D (1)]
88	D	0	3	3												Included with above
89	D	0	3	4												Included with above
90	D	0	3	5												Included with above
91	D	0	3	6												Included with above
92	D	0	3	8												Included with above
93	D	0	3	9												Included with above
94	D	0	4	0												Included with above
95	D	0	4	1												Included with above
96	D	0	4	3												Included with above
97	F	0	0	1												Included with above
98	F	0	0	2												Included with above
99	F	0	0	3												Included with above
100	F	0	0	4												Included with above
101	F	0	0	5												Included with above
102	F	0	3	9												Included with above
103	W	T	0	1												Included with above
104	W	T	0	2												Included with above
105	U	2	1	0												Included with above
106	D	0	0	1	179,000	P	T	0	4							Container Treatment Includes Debris
107	D	0	0	2												Included with above
108	D	0	0	3												Included with above
109	D	0	0	4												Included with above
110	D	0	0	5												Included with above
111	D	0	0	6												Included with above
112	D	0	0	7												Included with above
113	D	0	0	8												Included with above
114	D	0	0	9												Included with above
115	D	0	1	0												Included with above
116	D	0	1	1												Included with above
117	D	0	1	8												Included with above
118	D	0	1	9												Included with above

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)				B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process	
							(1) Process Codes (enter)	(2) Process Description [If a code is not entered in D (1)]
119	D	0	2	2				Included with above
120	D	0	2	8				Included with above
121	D	0	2	9				Included with above
122	D	0	3	0				Included with above
123	D	0	3	3				Included with above
124	D	0	3	4				Included with above
125	D	0	3	5				Included with above
126	D	0	3	6				Included with above
127	D	0	3	8				Included with above
128	D	0	3	9				Included with above
129	D	0	4	0				Included with above
130	D	0	4	1				Included with above
131	D	0	4	3				Included with above
132	F	0	0	1				Included with above
133	F	0	0	2				Included with above
134	F	0	0	3				Included with above
135	F	0	0	4				Included with above
136	F	0	0	5				Included with above
137	F	0	3	9				Included with above
138	W	T	0	1				Included with above
139	W	T	0	2				Included with above
140	U	2	1	0				Included with above
141								
142								
143								
144								
145								
146								
147								
148								
149								

XV. Map

Attach to this application a topographic map of the area extending to at least one (1) mile beyond property boundaries. The map must show the outline of the facility; the location of each of its existing and proposed intake and discharge structures; each of its dangerous waste treatment, storage, recycling, or disposal units; and each well where fluids are injected underground. Include all springs, rivers, and other surface water bodies in this map area, plus drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary. The instructions provide additional information on meeting these requirements.

XVI. Facility Drawing

All existing facilities must include a scale drawing of the facility (refer to Instructions for more detail).

XVII. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, recycling, and disposal areas; and sites of future storage, treatment, recycling, or disposal areas (refer to Instructions for more detail).

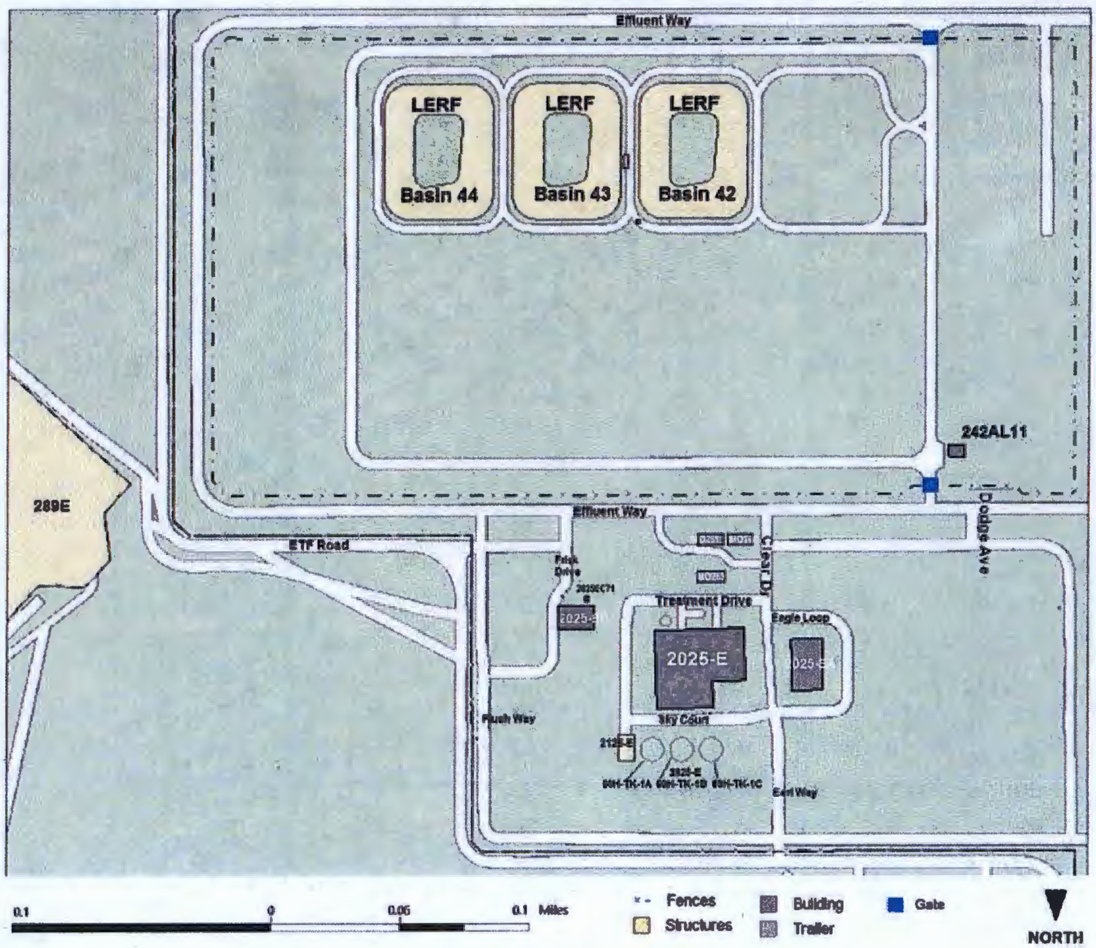
XVIII. Certifications

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

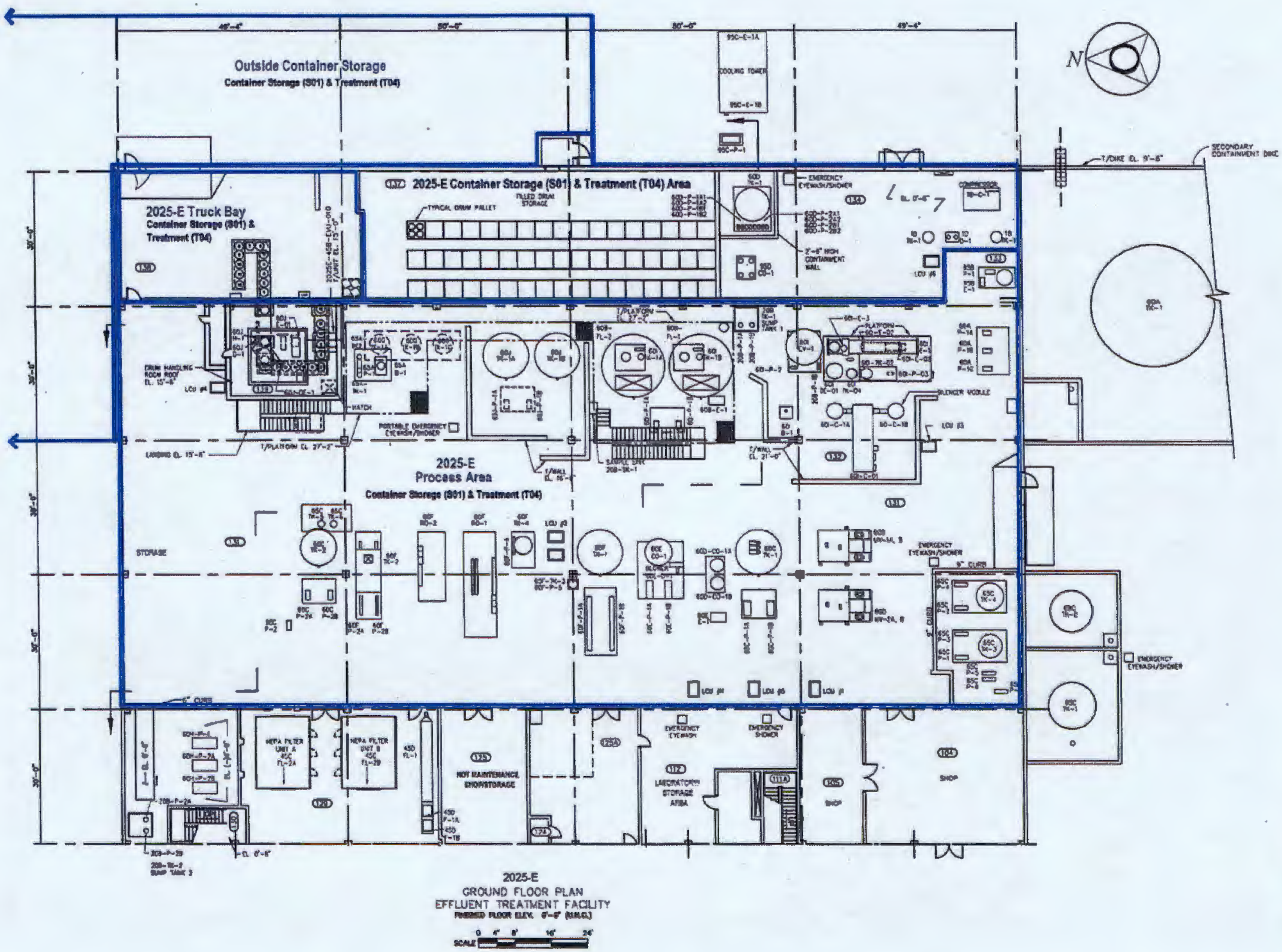
Operator Name and Official Title (type or print)	**Signature**	**Date Signed**
Kevin W. Smith, Manager U.S. Department of Energy Office of River Protection	K. W. Smith	6/19/17
Co-Operator Name and Official Title (type or print) Mark A. Lindholm President and Project Manager Washington River Protection Solutions, LLC	**Signature**	**Date Signed** 5/23/17
Co-Operator – Address and Telephone Number P.O. Box 850 Richland, WA 99352 (509) 376-3492		
Facility-Property Owner Name and Official Title (type or print) Kevin W. Smith, Manager U.S. Department of Energy Office of River Protection	**Signature** K. W. Smith	**Date Signed** 6/19/17

Comments

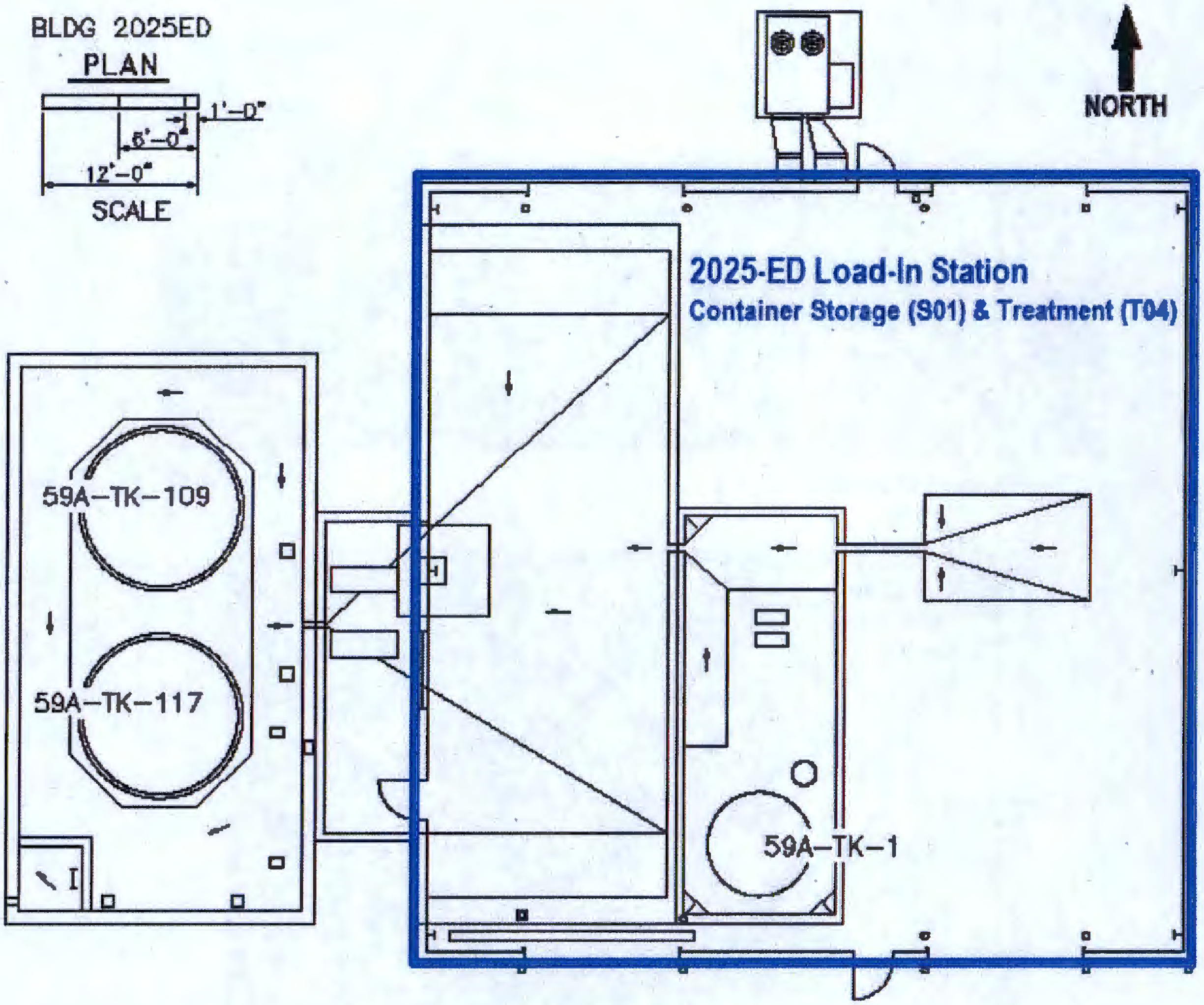
Photo 2/2010



A.1. LERF and 200 Area ETF



A.2. 2025-E ETF Ground Floor Plan



A.3. 2025-ED Load-In Station

A.4. 200 Area ETF Building 2025-E *Photo 9/2016*

A.5. 2025-E Process Area *Photo 3/2016*

A.6. 2025-E Container Storage Area Photo 9/2016

A.7. 2025-E Process Area Photo 3/2016

A.8. 2025-E Truck Bay Photo 3/2016

A.9. 2025-E Process Area Photo 3/2016

A.10. 2025-E Process Area Primary Train Photo 3/2016

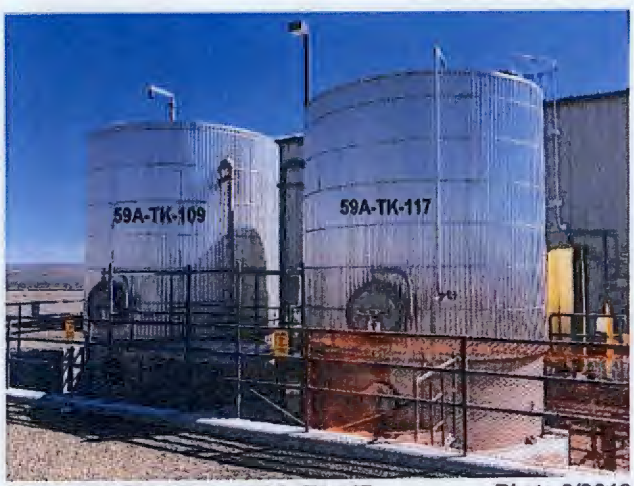
A.11. Outside Container Storage Area Photo 3/2016

A.12. 2025-ED Load-In Station *Photo 3/2016*

A.13. 2025-ED Load-In Station 59A-TK-1 and Tanker Truck *Photo 3/2016*

A.14. 20B-TK-1, Sump Tank 1 *Photo 2/2017*

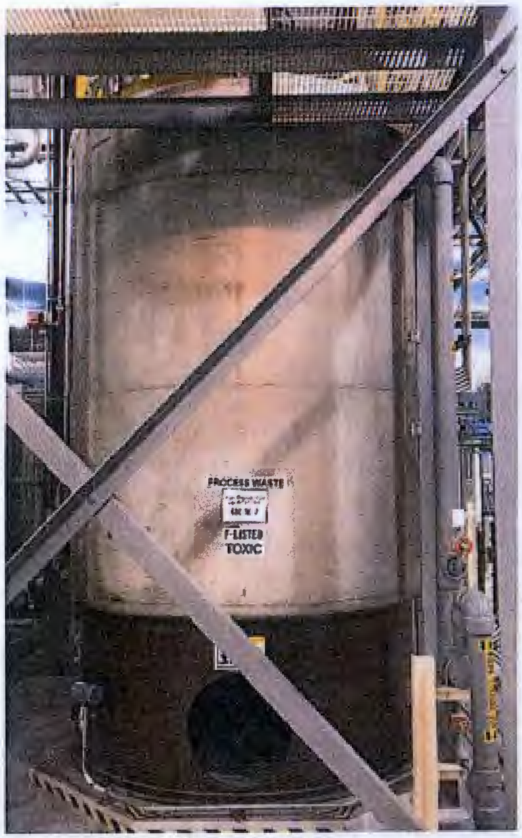
A.15. 20B-TK-2, Sump Tank 2 *Photo 2/2017*



A.16. 59A-TK-109 and 59A-TK-117 *Photo 8/2016*
2025-ED Load-In Station Tanks (permanently isolated)

A.17. 60A-TK-1, Surge Tank *Photo 1/2017*

A.18. pH Adjustment Tank 60C-TK-1 *Photo 1/2017*

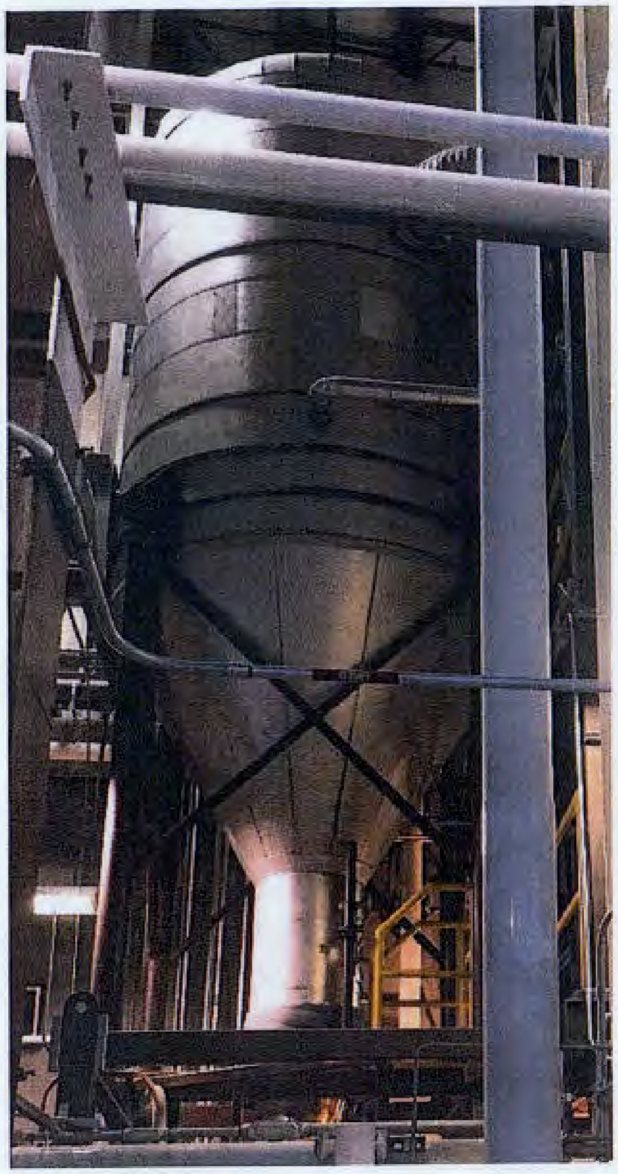


A.19. Effluent pH Adjustment Tank 60C-TK-2 *Photo 1/2017*

A.20. 1st RO Feed Tank 60F-TK-1 *Photo 1/2017*

A.21. 2nd RO Feed Tank 60F-TK-2 *Photo 1/2017*

A.22. 60H-TK-1A/1B/1C, Verification Tanks Photo 9/2016



A.23. 60I-EV-1 Photo 9/2016
Evaporator Vapor Body Vessel

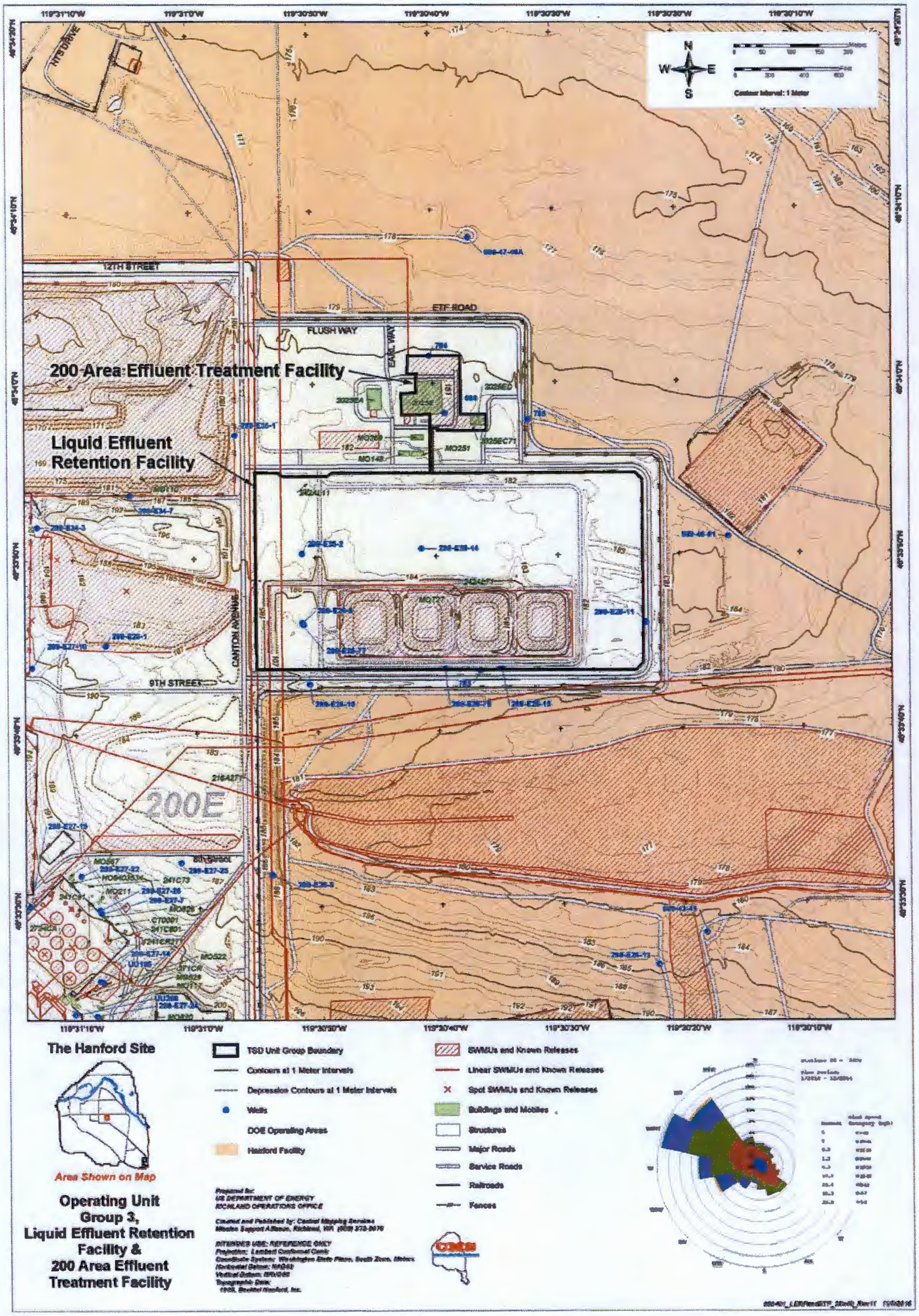
A.24. 60I-TK-1A Photo 2/2017
Secondary Waste Receiving Tank

A.25. 60I-TK-1B Secondary Waste Receiving Tank *Photo 2/2017*

A.26. 60I-TK-2 Distillate Flash Tank *Photo 2/2017*

A.27. 60J-TK-1A/1B, Concentrate Tanks *Photo 2/2017*

Addendum A.24


Contour Interval: 1 Meter
HYDRIVE
12TH STREET
ETF ROAD
FLUSH WAY
EARL WAY
200 Area Effluent Treatment Facility
Liquid Effluent Retention Facility
CANTON AVENUE
9TH STREET
200E
8th Street
The Hanford Site
Area Shown on Map
Operating Unit Group 3, Liquid Effluent Retention Facility & 200 Area Effluent Treatment Facility
TSD Unit Group Boundary
Contours at 1 Meter Intervals
Depression Contours at 1 Meter Intervals
Wells
DOE Operating Areas
Hanford Facility
SWMUs and Known Releases
Linear SWMUs and Known Releases
Spot SWMUs and Known Releases
Buildings and Mobiles
Structures
Major Roads
Service Roads
Railroads
Fences
Prepared for:
US DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
INTENDED USE: REFERENCE ONLY

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LIQUID EFFLUENT RETENTION FACILITY (LERF) & 200 AREA EFFLUENT TREATMENT FACILITY (ETF) ADDENDUM B WASTE ANALYSIS PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/25/2017	8C.2017.3F
08/25/2015	8C.2016.Q2

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ADDENDUM B
WASTE ANALYSIS PLAN

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ADDENDUM B
WASTE ANALYSIS PLAN

TABLE OF CONTENTS

TABLES

B. WASTE ANALYSIS PLAN

B.1 Introduction

In accordance with the regulations set forth in the Washington State Department of Ecology (Ecology) *Dangerous Waste Regulations*, Washington Administrative Code (WAC) 173-303-300, this waste analysis plan (WAP) has been prepared for operation of the Liquid Effluent Retention Facility (LERF) and the 200 Area Effluent Treatment Facility (200 Area ETF) located in the 200 East Area on the Hanford Site, Richland, Washington.

The purpose of this WAP is to ensure that adequate knowledge as defined in WAC 173-303-040, is obtained for dangerous and/or mixed waste accepted by and managed in LERF and 200 Area ETF. This WAP documents the sampling and analytical methods, and describes the procedures used to obtain this knowledge. This WAP also documents the requirements for generators sending aqueous waste to the LERF or 200 Area ETF for treatment. Throughout this WAP, the term generator includes any Hanford Site source, including treatment, storage, and disposal (TSD) units, whose process produces an aqueous waste.

LERF consists of three surface impoundments, which provide treatment and storage. The 200 Area ETF includes a tank system, which provides treatment and storage, and container management areas, which provides container storage and treatment. Additionally, this WAP discusses the sampling and analytical methods for the treated effluent (treated aqueous waste) that is discharged from 200 Area ETF as a non-dangerous, delisted waste to the State Approved Land Disposal Site (SALDS). Specifically, the WAP contains sampling and analysis requirements including quality assurance/quality control requirements, for the following:

- **Influent Waste Acceptance Process** - determines the acceptability of a particular aqueous waste at the LERF or 200 Area ETF pursuant to applicable Permit conditions, regulatory requirements, and operating capabilities prior to acceptance of the waste at the LERF or 200 Area ETF for treatment or storage. This includes documenting that wastes accepted for treatment at 200 Area ETF are within the treatability envelope required by the Final Delisting 200 Area ETF, Permit Condition 1.a.i. Refer to Section B.2.
- **Special Management Requirements** - identifies the special management requirements for aqueous wastes managed in the LERF or 200 Area ETF. Refer to Section B.3.
- **Influent Aqueous Waste Sampling and Analysis** - describes influent sampling and analyses used to characterize an influent aqueous waste to ensure proper management of the waste and for compliance with the special management requirements. Also includes rationale for analyses. Refer to Section B.4.
- **Treated Effluent Sampling and Analysis** - describes sampling and analyses of treated effluent (i.e., treated aqueous waste) for compliance with Discharge Permit Number ST0004500; and Final Delisting 200 Area ETF [40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3) and the corresponding State Final Delisting issued pursuant to WAC 173-303-910(3) limits]. Also includes rationale for analyses. Refer to Section B.5.
- **200 Area ETF Generated Waste Sampling and Analysis** - describes the sampling and analyses used to characterize the secondary waste streams generated from the treatment process and to characterize waste generated from maintenance and operations activities. Also includes rationale for analyses. Characterization and designation of wastes generated from maintenance and operations activities are conducted pursuant to WAC 173-303-170 and are not subject to the permit requirements of WAC 173-303-800. These descriptions are included in this WAP for purposes of completeness, but are not enforceable conditions of this WAP or the permit. Refer to Section B.6.
- **Quality Assurance and Quality Control** - ensures the accuracy and precision of sampling and analysis activities. Refer to Section B.7.

This WAP meets the specific requirements of the following:

- Land Disposal Restrictions Treatment Exemption for the LERF under 40 CFR 268.4, U.S. Environmental Protection Agency (EPA), December 6, 1994 Memo, Mr. Dan Duncan, EPA to Ms. June Hennig, DOE, *Liquid Effluent Retention Facility (LERF) Land Disposal Restrictions Treatment Exemption – Regulatory Interpretation*.
- Final Delisting 200 Area ETF [40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3)].
- Corresponding State Final Delisting issued pursuant to WAC 173-303-910(3).
- Discharge Permit Number ST0004500, as amended.
- Hanford Facility Dangerous Waste Permit (Permit) WA7890008967, as amended.

Some Permit requirements from Discharge Permit Number ST0004500 are included in this WAP for completeness. In addition, generator requirements for designation of wastes generated by LERF and 200 Area ETF from operation and maintenance activities are also included in this WAP for completeness. The Discharge Permit Number ST0004500 requirements are not within the scope of Resource Conservation and Recovery Act (RCRA) or WAC 173-303 or subject to the permit requirements of WAC 173-303-800. Therefore, revisions of this WAP that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to review or approval by Ecology. Any other revisions to this WAP will be incorporated through the Permit modification process as necessary to demonstrate compliance with requirements of this Permit, including Permit Conditions I.E.7 and I.E.8.

B.1.1 Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility Description

The LERF and 200 Area ETF comprise an aqueous waste treatment system located in the 200 East Area. Both LERF and 200 Area ETF may receive aqueous waste through several inlets. 200 Area ETF can receive aqueous waste through three inlets. First, 200 Area ETF can receive aqueous waste directly from the LERF. Second, aqueous waste can be transferred from the 2025-ED Load-In Station to 200 Area ETF. Third, aqueous waste can be transferred from containers (e.g., carboys, drums) to the 200 Area ETF through either the Secondary Waste Receiving Tanks or the Concentrate Tanks. The Load-In Station is located just east of building 2025-E and currently consists of three storage tanks and a pipeline that connects to either LERF or 200 Area ETF through fiberglass pipelines with secondary containment.

The LERF can receive aqueous waste through four inlets. First, aqueous waste can be transferred to LERF through a dedicated pipeline from the 200 West Area. Second, aqueous waste can be transferred through a pipeline that connects LERF with the 242-A Evaporator. Third, aqueous waste also can be transferred to LERF from a pipeline that connects LERF to the Load-In Station. Finally, aqueous waste can be transferred into LERF through a series of sample ports located at each basin.

The LERF consists of three lined surface impoundments. Aqueous waste from LERF is pumped to 200 Area ETF through a double walled fiberglass pipeline. The pipeline is equipped with leak detection located in the annulus between the inner and outer pipes. Each basin is equipped with six available sample risers constructed of 6-inch-perforated pipe. A seventh sample riser in each basin is dedicated to influent waste receipt piping, and an eighth riser in each basin contains liquid level instrumentation. Each riser extends along the sides of each basin from the top to the bottom of the basin. Detailed information on the construction and operation of the LERF is provided in Addendum C, Process Information.

200 Area ETF is designed to treat the contaminants anticipated in process condensate from the 242-A Evaporator and other aqueous wastes from the Hanford Site. Section B.1.2 provides more information on the sources of these wastes.

The capabilities of 200 Area ETF were confirmed through pilot plant testing. A pilot plant was used to test surrogate solutions that contained constituents of concern anticipated in aqueous wastes on the

Hanford Site. The pilot plant testing served as the basis for a demonstration of the treatment capabilities of 200 Area ETF in the *200 Area Effluent Treatment Facility Delisting Petition* (DOE/RL-92-72).

200 Area ETF consists of a primary and a secondary treatment train (Figure C.4 and C.5). The primary treatment train removes or destroys dangerous and mixed waste components from the aqueous waste.

In the secondary treatment train, the waste components are concentrated and dried into a powder. This waste is containerized, and transferred to a waste treatment, storage, and/or disposal (TSD) unit.

Each treatment train consists of a series of operations. The primary treatment train includes the following:

- Surge tank
- Filtration
- Ultraviolet light oxidation (UV/OX)
- pH adjustment
- Hydrogen peroxide decomposition
- Degasification
- Reverse osmosis (RO)
- Ion exchange
- Verification

The secondary treatment train uses the following:

- Secondary waste receiving
- Evaporation (with mechanical vapor recompression)
- Concentrate staging
- Thin film drying
- Container handling
- Supporting systems

A dry powder waste is generated from the secondary treatment train, from the treatment of an aqueous waste. The secondary waste treatment system typically receives and processes by-products generated from the primary treatment train. However, in an alternate operating scenario, some aqueous wastes may be fed to the secondary treatment train before the primary treatment train.

The treated effluent is contained in verification tanks where the effluent is sampled to confirm that the effluent meets the delisting criteria. Under 40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3), the treated effluent from 200 Area ETF is considered a delisted waste; that is, the treated effluent is no longer a listed dangerous waste subject to the hazardous waste management requirements of RCRA provided that the delisting criteria are satisfied and the treated effluent does not exhibit a dangerous characteristic. The treated effluent is discharged under the Discharge Permit Number ST0004500 as a nondangerous, delisted waste to the SALDS, located in the 600 Area, north of the 200 West Area. A portion of the treated wastewater from the Verification Tanks is recycled as service water throughout the facility; for example, it is used to dilute bulk acid and caustic to meet processing needs, thereby reducing the demand for process water.

B.1.2 Sources of Aqueous Waste

200 Area ETF was intended and designed to treat a variety of mixed wastes. However, process condensate from the 242-A Evaporator was the only mixed waste initially identified for storage and treatment in the LERF and 200 Area ETF. As cleanup activities at Hanford progress, many of the aqueous wastes generated from site remediation and waste management activities are sent to the LERF and 200 Area ETF for treatment and storage. A brief discussion of waste streams that may be managed

by LERF and 200 Area ETF in the future may be found in the 200 Area ETF Delisting Petition (DOE/RL-92-72). Prior to management of any new waste streams, it may be necessary to modify this WAP through the permit modification process to ensure that adequate knowledge of such new waste streams is available prior to management of them in LERF and 200 Area ETF.

The 242-A process condensate is a dangerous waste because it is derived from a listed, dangerous waste stored in the Double-Shell Tank (DST) System. The DST waste is transferred to the 242-A Evaporator where the waste is concentrated through an evaporation process. The concentrated slurry waste is returned to the DST System, and the evaporated portion of the waste is recondensed, collected, and transferred as process condensate to the LERF.

Other aqueous wastes that are treated and stored at the LERF and 200 Area ETF include, but are not limited to the following Hanford wastes:

- Contaminated groundwater from pump-and-treat remediation activities such as groundwater from the 200-UP-1 Operable Unit.
- Purgewater from groundwater monitoring activities.
- Water from deactivation activities, such as water from the spent fuel storage basins at deactivated reactors (e.g., N Reactor).
- Laboratory aqueous waste from unused samples and sample analyses.
- Leachate from landfills, such as the Environmental Restoration Disposal Facility.
- Any dilute waste, which may be accepted for treatment and within the scope of wastewaters that maybe delisted under terms of the revised delisting (40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3)).

Most of these aqueous wastes are accumulated in batches in a LERF basin for interim storage and treatment through pH and flow equalization before final treatment in 200 Area ETF. However, some aqueous wastes, such as 200-UP-1 Groundwater, maybe treated on a flow through basis in LERF en route to 200 Area ETF for final treatment. The constituents in these aqueous wastes are common to the Hanford Site and were considered in pilot plant testing or in vendor tests, either as a constituent or as a family of constituents. According to the Final Delisting 200 Area ETF, and Permit Condition III.3.B.7, all wastes accepted for treatment at 200 Area ETF must be within a specified treatability envelope that ensures that wastes will be within the treatment capability of 200 Area ETF.

B.2 Influent Waste Acceptance Process

Throughout the acceptance process, there are specific criteria required for an influent waste (i.e., aqueous waste) to be accepted at the LERF and/or 200 Area ETF. These criteria are identified in the following sections and summarized in Table B.2. The process of accepting a waste into the LERF and 200 Area ETF systems involves a series of steps, as follows.

- **Waste information:** The generator of an aqueous waste works with LERF and 200 Area ETF personnel to provide characterization data of the waste stream (Section B.2.1).
- **Waste management decision process:** LERF and 200 Area ETF management decision is based on a case-by-case evaluation of whether an aqueous waste stream is acceptable for treatment or storage at LERF and the 200 Area ETF. The evaluation has two categories:
    - **Regulatory acceptability:** a review to determine if there are any, regulatory concerns that would prohibit the storage or treatment of an aqueous waste in the LERF or 200 Area ETF; e.g., treatment would meet permit conditions that would comply with applicable regulations.
    - **Operational acceptability:** an evaluation to determine if there are any operational concerns that would prohibit the storage or treatment of an aqueous waste in the LERF or 200 Area ETF and storage of treatment residuals; e.g., determine treatability and compatibility or safety considerations (Section B.2.2.2).

B.2.1 Waste Information

When an aqueous waste stream is identified for treatment or storage in the LERF or 200 Area ETF, the generator is required to characterize the waste stream according to the requirements in Section B.2.1.1 and document the results of characterization on an aqueous waste profile sheet. This requirement is the first waste acceptance criterion.

The LERF and 200 Area ETF personnel work with the generators to ensure that the necessary information is collected for the characterization of a waste stream (i.e., the appropriate analyses or adequate knowledge), and that the information provided on the waste profile sheet is complete. The completed waste profile sheet is maintained in the Hanford Facility Operating Record, LERF and 200 Area ETF File according to Permit Condition II.I.1.j.

B.2.1.1 Waste Characterization

Because the constituents in the individual aqueous waste streams vary, each waste stream is characterized and evaluated for acceptability on a case-by-case basis. The generator is required to designate an aqueous waste, which generally will be based on analytical data. However, a generator may use knowledge to substantiate the waste designation, or for general characterization information. Examples of acceptable knowledge include the following:

- Documented data or information on processes similar to that which generated the aqueous waste stream.
- Information/documentation that the waste stream is from specific, well documented processes, e.g., F-listed wastes.
- Information/documentation that sampling/analyzing a waste stream would pose health and safety risks to personnel.
- Information/documentation that the waste stream does not lend itself to collecting a laboratory sample for example, wastewater collected (e.g., sump, tank) where the source water characterization is documented. Typically, these circumstances occur at decommissioned buildings or locations, not at operating units.

When a generator performs characterization of a dangerous and/or mixed waste stream based on knowledge, LERF and 200 Area ETF personnel review the knowledge as part of the waste acceptance process to ensure the knowledge satisfies the definition of *knowledge* in WAC 173-303-040. Specifically, LERF and 200 Area ETF personnel review the generator's processes to verify the integrity of the knowledge, and determine whether the knowledge is current and consistent with requirements of this WAP. LERF and 200 Area ETF management or their designee determines the final decision on the adequacy of the knowledge. The persons reviewing generator process knowledge and those making decisions on the adequacy of knowledge are trained according to the requirements of Addendum G, Personnel Training.

The generator is also responsible for identifying Land Disposal Restrictions (LDRs) treatment standards applicable to the influent aqueous waste as part of the characterization, as required under 40 CFR 268.40 incorporated by reference by WAC 173-303-140. Because the 200 Area ETF main treatment train is a Clean Water Act, equivalent treatment unit [40 CFR 268.37(a)] incorporated by reference by WAC 173-303-140, generators are not required to identify underlying hazardous constituents for characteristic wastes pursuant to 40 CFR 268.9, incorporated by reference by WAC 173-303-140, for wastewaters (i.e., <1 percent total suspended solids and <1 percent total organic carbon). The 200 Area ETF secondary waste (e.g., powder) reflects a change in LDR treatability group (i.e., wastewater to non-wastewater) so there is a new LDR point of generation, at which point any characteristic and associated underlying hazardous constituents must be identified. Therefore, generators of a non-wastewater may be required to identify underlying hazardous constituents for characteristic wastes pursuant to 40 CFR 268.9, incorporated by reference by WAC 173-303-140.

When analyzing an aqueous waste stream for LERF and 200 Area ETF waste acceptance characterization, a generator is required to use the target list of parameters identified in Table B.3, of this WAP. This requirement is in addition to any analysis required for purposes of designation under WAC 173-303-070. These data are used by LERF and 200 Area ETF to verify the treatability of an aqueous waste stream, and to develop a treatment plan for the waste after acceptance. Refer to Table B.6, for the corresponding analytical methods. The generator may use knowledge in lieu of some analyses, as determined by LERF and 200 Area ETF management or their designee, if the knowledge satisfies the definition of *knowledge* in WAC 173-303-040. For example if a generator provides information that the process generating an aqueous waste does not include or involve organic chemicals, analyses for organic compounds likely would not be required. Additional analyses could be required if historical information and/or knowledge indicate that an aqueous waste contains constituents not included in the target list of parameters.

The characterization and historical information are documented in the waste profile sheet, which is discussed in the following section and is part of the Hanford Facility Operating Record, LERF and 200 Area ETF File according to Permit Condition II.I.

B.2.1.2 Aqueous Waste Profile Sheet

The waste profile sheet documents the characterization of each new aqueous waste stream. The profile includes a detailed description of the source, volume, waste designation and applicable LDR treatment standards, and physical nature (wastewater or non-wastewater) of the aqueous waste. For an aqueous waste to be accepted for treatment or storage in the LERF or 200 Area ETF, each new waste stream generator is required to complete and provide this form to LERF and 200 Area ETF management. Each generator also is required to provide the analytical data and/or knowledge used to designate the aqueous waste stream according to WAC 173-303-070 and to determine the chemical and physical nature of the waste.

The LERF and 200 Area ETF management determine whether the information on the waste profile sheet is sufficient according to the criteria above. The LERF and 200 Area ETF management use this information to evaluate the acceptability of the aqueous waste stream for storage and treatment in the LERF and 200 Area ETF, and to determine if the secondary waste generated from treatment is acceptable for storage at the 200 Area ETF and has a defined path forward to final disposal.

B.2.2 Waste Management Decision Process

All aqueous waste under consideration for acceptance must be characterized using analytical data and/or knowledge. This information is used to determine the acceptability of an aqueous waste stream. The LERF and 200 Area ETF Facility Manager or their designee is responsible for making the decision to accept or reject an aqueous waste stream. The management decision to accept any aqueous waste stream is based on an evaluation of regulatory acceptability and operational acceptability. Each evaluation uses acceptance criteria, which were developed to ensure that an aqueous waste is managed in a safe, environmentally sound, and in compliance with this Permit. The following sections provide detail on the acceptance evaluation and the acceptance criteria.

An aqueous waste stream could be rejected for one of the following reasons:

- The paperwork and/or laboratory analyses from the generator are insufficient.
- Discrepancies with the regulatory and operational acceptance criteria cannot be reconciled, including:
    - An aqueous waste, which is not allowed under the current Final Delisting 200 Area ETF, and LERF and 200 Area ETF management elect not to pursue an amendment, or the Final Delisting 200 Area ETF cannot be amended (Section B.2.2.1).
    - An aqueous waste is incompatible with LERF liner materials or with other aqueous waste in LERF and no other management method is available (Section B.2.2.3.1).
- Adequate storage or treatment capacity is not available.

B.2.2.1 Regulatory Acceptability

Each aqueous waste stream is evaluated on a case-by-case basis to determine if there are any regulatory concerns that would preclude the storage or treatment of a waste in the LERF or 200 Area ETF based on the criteria in Sections B.2.2.1.1. Before an aqueous waste can be stored or treated in either the LERF or 200 Area ETF, the waste designation must be determined. Information on the waste designation of an aqueous waste is documented in the waste profile sheet. This information is used to confirm that treating or storing the aqueous waste in the LERF or 200 Area ETF is allowed under and in compliance with WAC 173-303, Permit (WA7890008967), Final Delisting 200 Area ETF in 40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3), and the corresponding State-Issued Delisting for 200 Area ETF.

B.2.2.1.1 Dangerous Waste Regulations, State and Federal Delisting Actions, and Permits

Before an aqueous waste stream is sent to the LERF or 200 Area ETF, the generator will characterize and designate the stream with the appropriate dangerous/hazardous waste numbers according to WAC 173-303-070. Addendum A, the Final Delisting 200 Area ETF and the corresponding State-Issued Delisting identify the specific waste numbers for dangerous/mixed waste that can be managed in the LERF and 200 Area ETF. Dangerous waste designated with waste numbers not specified in these documents cannot be treated or stored in the LERF or 200 Area ETF, unless the documents are appropriately modified.

Additionally, aqueous wastes designated with listed waste numbers identified in the Final Delisting 200 Area ETF and the corresponding State-Issued Delisting will be managed in accordance with the conditions of the delisting, or an amended delisting.

B.2.2.2 Operational Acceptability

Because the operating configuration or operating parameters at the LERF and 200 Area ETF can be adjusted or modified, most aqueous waste streams generated on the Hanford Site can be effectively treated to below Delisting and Discharge Permit limits. Because of this flexibility, it would be impractical to define numerical acceptance or decision limits. Such limits would constrain the acceptance of appropriate aqueous waste streams for treatment at the LERF and 200 Area ETF. The versatility of the LERF and 200 Area ETF is better explained in the following examples:

- The typical operating configuration of 200 Area ETF is to process an aqueous waste through the UV/OX unit first, followed by the RO unit. However, high concentrations of nitrates may interfere with the performance of the UV/OX. In this case, 200 Area ETF could be configured to process the waste in the RO unit prior to the UV/OX unit.
- For a small volume aqueous waste with high concentrations of some anions and metals, the approach may be to first process the waste stream in the secondary treatment train. This approach would prevent premature fouling or scaling of the RO unit. The liquid portion (i.e., untreated overheads from 200 Area ETF evaporator and thin film dryer) would be sent to the primary treatment train.
- An aqueous waste with high concentrations of chlorides and fluorides may cause corrosion problems when concentrated in the secondary treatment train. One approach is to adjust the corrosion control measures in the secondary treatment train. An alternative may be to blend this aqueous waste in a LERF basin with another aqueous waste, which has sufficient dissolved solids, such that the concentration of the chlorides in the secondary treatment train would not pose a corrosion concern.
- Some metal salts (e.g., barium sulfate) tend to scale the RO membranes. In this situation, descalants used in the treatment process may be increased.
- Any effluent that does not meet these limits in one pass through 200 Area ETF treatment process is recycled to 200 Area ETF for re-processing.

There are some aqueous wastes, whose chemical and physical properties preclude that waste from being treated or stored at the LERF or 200 Area ETF. Accordingly, an aqueous waste is evaluated to determine if it is treatable, if it would impair the efficiency or integrity of the LERF or 200 Area ETF, and if it is compatible with materials in these units. This evaluation also determines if the aqueous waste is compatible with other aqueous wastes managed in the LERF.

The waste acceptance criteria in this category focus on determining treatability of an aqueous waste stream, and on determining any operational concerns that would prohibit the storage or treatment of an aqueous waste stream in the LERF or 200 Area ETF. The chemical and physical properties of an aqueous waste stream are determined as part of the waste characterization, and are documented on the waste profile sheet and compared to the design of the units to determine whether an aqueous waste stream is appropriate for storage and treatment in the LERF and 200 Area ETF. All decisions and supporting rationale and data will be documented in the Hanford Facility Operating Record, LERF and 200 Area ETF File according to Permit Condition II.I.

B.2.2.3 Special Requirements Pertaining to Land Disposal Restrictions

Containers of 200 Area ETF secondary waste are transferred to a storage or final disposal unit, as appropriate (e.g., the Central Waste Complex or to the Environmental Restoration Disposal Facility). 200 Area ETF personnel provide the analytical characterization data and necessary process knowledge for the waste to be managed by the receiving staff, and the appropriate LDR documentation.

The following information on the secondary waste is included on the LDR documentation provided to the receiving unit:

- Dangerous waste numbers (as applicable).
- Determination on whether the waste is restricted from land disposal according to the requirements of 40 CFR 268 incorporated by reference by WAC 173-303-140 (i.e., the LDR status of the waste).

The waste tracking information associated with the transfer of waste:

- Waste analysis results

Generally, the operating parameters or operating configuration at the LERF or 200 Area ETF can be adjusted or modified to accommodate these properties. However, in those cases where a treatment process or operating configuration cannot be modified, the aqueous waste stream will be excluded from treatment or storage at the LERF or 200 Area ETF. Additionally, an aqueous waste stream is evaluated for the potential to deposit solids in a LERF basin (i.e., whether an aqueous waste contains sludge or could precipitate solids). This evaluation will also consider whether the blending or mixing of two or more aqueous waste streams will result in the formation of a precipitate. However, because the waste streams managed in the LERF and 200 Area ETF are generally dilute, the potential for mixing waste streams and forming a precipitate is low; no specific compatibility tests are performed. Filtration at the waste source could be required before acceptance into LERF. Waste streams with the potential to form precipitates in LERF or that cannot be blended with other waste streams to avoid precipitate formation are not accepted for treatment at LERF and 200 Area ETF. The 2025-ED Load-In Station has the ability to perform filtration on incoming waste streams going to both the LERF and 2025-ED Load In Station. See additional discussions of precipitate formation and compliance with LDR requirements in Section B.3. Similar filtration requirements could apply to aqueous waste fed directly to 200 Area ETF without interim treatment in LERF.

To determine if an aqueous waste meets the criterion of treatability, specific information is required. Treatability of a waste stream is evaluated from characterization data provided by the generator as verified through the waste acceptance process, the 200 Area waste acceptance criteria, and the treatability envelope for the 200 Area ETF as documented in Tables C.1 and C.2 of the November 29, 2001 delisting petition. Generators will also provide characterization data to identify those physical and chemical properties that would interfere with, or foul 200 Area ETF treatment process in consultation with LERF and 200 Area ETF representatives. In some instances, knowledge that meets the definition of *knowledge* in WAC 173-303-040 is used for purposes of identifying a chemical or physical property that would be of concern. For example, the generator could provide knowledge that the stream has two phases (an oily phase and an aqueous phase). In this case, if the generator could not physically separate the two phases, the aqueous waste stream would be rejected because the oily phase could compromise some of the treatment equipment. Typically, analyses for the following parameters are required to evaluate treatability and operational concerns:

- total dissolved solids
- total organic carbon
- total suspended solids
- specific conductivity
- pH
- alkalinity
- ammonia
- barium
- calcium
- chloride
- fluoride
- iron
- magnesium
- nitrate
- nitrite
- phosphate
- potassium
- silicon
- sodium
- sulfate

These constituents are identified in Table B.2, which is the list of target analytes used for waste characterization and waste acceptance evaluation.

B.2.2.3.1 Compatibility

Corrosion Control. Because of the materials of construction used in 200 Area ETF, corrosion is generally not a concern with new aqueous waste streams. Additionally, these waste streams are managed in a manner that minimizes corrosion. To ensure that a waste will not compromise the integrity of 200 Area ETF tanks and process equipment, each waste stream is assessed for its corrosion potential as part of the compatibility evaluation. This assessment usually focuses on chloride and fluoride concentrations; however, the chemistry of each new waste also is evaluated for other parameters that could cause corrosion.

Compatibility with Liquid Effluent Retention Facility Liner and Piping. As part of the acceptance process, the criteria of compatibility with the LERF liner materials are evaluated for each aqueous waste stream. This evaluation is performed using knowledge (as defined by WAC 173-303-040) of constituent concentrations in the aqueous waste stream or using constituent concentrations obtained by analyzing the waste stream for the constituents identified in Table B.1 using the analytical methods for these constituents in Section B.8. Then, the constituent concentrations in the waste stream are compared to the decision criteria in Table B.1. If all constituent concentrations are below the decision criteria, then the waste stream is considered compatible with the LERF liner and may be accepted for treatment. Otherwise, the waste stream is considered incompatible with the LERF liner, and it cannot be accepted for treatment in the LERF basins. However, a waste stream may still be acceptable for treatment in 200 Area ETF if it is fed directly to 200 Area ETF, bypassing the LERF Basins. Results of this evaluation are documented in the Hanford Facility Operating Record, LERF and 200 Area ETF File according to Permit Condition II.I. The rational for establishing the liner compatibility constituents and decision criteria in Table B.1 is as follows: The high-density polyethylene liners in the LERF basins potentially are vulnerable to the presence of certain constituents that might be present in some aqueous waste. Using EPA SW-846, Method 9090, the liner materials were tested to evaluate compatibility between aqueous waste stored in the LERF and synthetic liner components. Based on the data from the compatibility test and vendor data on the liner materials, several constituents and parameters were identified as potentially harmful (at high concentrations) to the integrity of the liners. From these data and the application of safety factors, concentration limits in Table B.1 were established.

The strategy for protecting the integrity of a LERF liner is to establish upfront that an aqueous waste is compatible before the waste is accepted into LERF. Characterization data on each new aqueous waste stream are compared to the limits outlined in Table B.1 to ensure compatibility with the LERF liner material before acceptance into the LERF.

Before a waste stream is processed at the 242-A Evaporator, the generator reviews DST analytical data and a process condensate profile is developed to ensure the process condensate is compatible with the LERF liner. For flow through aqueous wastes like the 200-UP-1 Groundwater, characterization data will be obtained and reviewed every two years to ensure that liner compatibility is maintained.

In some instances, knowledge may be adequate to determine that an aqueous waste is compatible with the LERF liner. When knowledge is used, it must satisfy the definition of *knowledge* in WAC 173-303-040. In those instances where knowledge is adequate, the waste characterization would likely not require analysis for these parameters and constituents. Storm water is an example where knowledge is adequate to determine that this aqueous waste is compatible with the LERF liner.

Compatibility with Other Waste. Some aqueous wastes, especially small volume streams, are accumulated in the LERF with other aqueous waste. Before acceptance into the LERF, the aqueous waste stream is evaluated for its compatibility with the resident aqueous waste(s). The evaluation focuses on the potential for an aqueous waste to react with another waste (40 CFR 264, Appendix V, *Examples of Potentially Incompatible Wastes*) including formation of any precipitate in the LERF basins.

However, the potential for problems associated with commingling aqueous wastes is very low due to the dilute nature of the wastes; this evaluation confirms the compatibility of two or more aqueous wastes from different sources. Compatibility is determined by evaluating parameters such as pH, ammonia, and chloride. No specific analytical test for compatibility is performed.

If it is determined that an aqueous waste stream is incompatible with other aqueous waste streams, alternate management scenarios are available. For example, another LERF basin that contains a compatible aqueous waste(s) might be used, or the aqueous waste stream might be fed directly into 200 Area ETF for treatment. In any case, potentially incompatible waste streams are not mixed, and all aqueous waste is managed in a way that precludes a reaction, degradation of the liner, or interference with 200 Area ETF treatment process.

B.2.3 Periodic Review Process

In accordance with WAC 173-303-300(4)(a), an influent aqueous waste will be periodically reviewed as necessary to ensure that the characterization is accurate and current. At a minimum, an aqueous waste stream will be reviewed in the following situations.

- The LERF and 200 Area ETF management have been notified, or have reason to believe that the process generating the waste has changed.
- The LERF and 200 Area ETF management note an increase or decrease in the concentration of a constituent in an aqueous waste stream, beyond the range of concentrations that was described or predicted in the waste characterization.
- Waste streams will be reviewed every two years.

In these situations, LERF and 200 Area ETF management will review the available information. If existing analytical information is not sufficient, the generator may be asked to review and update the current waste characterization, to supply a new WPS, or re-sample and re-analyze the aqueous waste, as necessary. Other situations that might require a re-evaluation of a waste stream are discussed in the following sections.

B.2.4 Record/Information and Decision

The information and data collected throughout the acceptance process, and the evaluation and decision on whether to accept an influent aqueous waste stream for treatment or storage in the LERF or 200 Area ETF are documented as part of Hanford Facility Operating Record, LERF and 200 Area ETF File pursuant to

Permit Condition II.I. Specifically, the Hanford Facility Operating Record, LERF and 200 Area ETF File contains the following components on a new influent aqueous waste stream:

- The signed WPS for each aqueous waste stream and analytical data.
- Knowledge used to characterize a dangerous/mixed waste (under WAC 173-303), and information supporting the adequacy of the knowledge.
- The evaluation on whether an aqueous waste stream meets the waste acceptance criteria, including:
    - The evaluation for regulatory acceptability including appropriate regulatory approvals.
    - The evaluation for LERF liner compatibility and for compatibility with other aqueous waste.

Table B.1. General Limits for Liner Compatibility

Chemical Family	Constituent(s) or Parameter(s)[1]	Limit[2] (sum of constituent concentrations)
Alcohol/glycol	1-butanol	500,000 mg/L 500,000 ppm
Alkanone[3]	acetone	200,000 mg/L 200,000 ppm
Alkenone[4]	none targeted	N/A
Aromatic/cyclic hydrocarbon	acetophenone, benzene, carbozole, chrysene, cresol, di-n-octyl phthalate, diphenylamine, isophorone, pyridine, tetrahydrofuran	2,000 mg/L 2,000 ppm
Halogenated hydrocarbon	arochlors, carbon tetrachloride, chloroform, hexachlorobenzene, lindane (gamma-BHC), hexachlorocyclopentadiene, methylene chloride, p-chloroaniline, tetrachloroethylene, 2,4,6-trichlorophenol	2,000 mg/L 2,000 ppm
Aliphatic hydrocarbon	none targeted	N/A
Ether	dichloroisopropyl ether	2,000 mg/L 2,000 ppm
Other hydrocarbons	acetontrile, carbon disulfide, n-nitrosodimethylamine, tributyl phosphate	2,000 mg/L 2,000 ppm
Oxidizers	none targeted	NA
Acids, Bases, Salts	ammonia, cyanide, anions, cations	100,000 mg/L 100,000 ppm
pH	pH	0.5 < pH < 13.0

[1] Analytical methods for the parameters and constituents are provided in Section B.8.

[2] Analytical data are evaluated using the following 'sum of the fraction' technique. The individual constituent concentration is evaluated against the compatibility limit for its chemical family. The sum of the evaluations must be less than 1. pH is not part of this evaluation.

$$\sum_{n=1}^{i}\left(\frac{Conc_n}{LIMIT_n}\right) \leq 1$$

[3] Ketone containing saturated alkyl group(s)

[4] Ketone containing unsaturated alkyl group(s)

Where 'i' is the number of organic constituents detected

mg/L = milligrams per liter

ppm = parts per million

NA = not applicable

Table B.2. Waste Acceptance Criteria

General Criteria Category	Criteria Description
1. Characterization	A. Each generator must provide an aqueous waste profile.
	B. Each generator must designate the aqueous waste stream.
	C. Each generator must provide analytical data and/or knowledge.
2. Regulatory acceptability	A. The LERF and 200 Area ETF can store and treat influent aqueous wastes with waste numbers identified in Addendum A for the LERF and 200 Area ETF, and the Final Delisting 200 Area ETF, 40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3).
	B. The aqueous waste must comply with conditions of the Discharge Permit.
3. Operational acceptability	A. Determine whether an aqueous waste stream is treatable, considering: 1. Whether the removal and destruction efficiencies on the constituents of concern will be adequate to meet the Discharge Permit and Delisting levels 2. Other treatability concerns; analyses for this evaluation may include: total dissolved solids — iron total organic carbon — magnesium total suspended solids — nitrate specific conductivity — nitrite alkalinity — phosphate ammonia — potassium barium — silicon calcium — sodium chloride — sulfate fluoride — pH
	B. Determine whether an aqueous waste stream is compatible, considering: 1. Whether an aqueous waste stream presents corrosion concerns with respect to 200 Area ETF; analysis may include chloride and fluoride. 2. Whether an aqueous waste stream is compatible with LERF liner materials, compare characterization data to the liner compatibility limits (Table B.1). 3. Whether an aqueous waste stream is compatible with other aqueous waste(s), 40 CFR 264, Appendix V, comparison will be used.

B.3 Special Management Requirements

Special management requirements for aqueous wastes that are managed in the LERF or 200 Area ETF are discussed in the following section.

B.3.1 Land Disposal Restriction Compliance at Liquid Effluent Retention Facility

Because LERF provides treatment through flow and pH equalization, a surface impoundment treatment exemption from the land disposal restrictions was granted in accordance with 40 CFR 268.4, and WAC 173-303-040. This treatment exemption is subject to several conditions, including a requirement that the WAP address the sampling and analysis of the treatment 'residue' [40 CFR 268.4(a)(2)(i) and WAC 173-303-300(5)(h)(i) and (ii)] to ensure the 'residue' meets applicable treatment standards. Though the term 'residue' is not specifically defined, this condition further requires that sampling must be designed to represent the "sludge and the supernatant" indicating that a residue may have a sludge (solid) and supernatant (liquid) component.

Solid residue is not anticipated to accumulate in a LERF basin for the following reasons:

- Aqueous waste streams containing sludge would not be accepted into LERF under the acceptance criteria of treatability (Section B.2.2.3.1).
- No solid residue was reported from process condensate discharged to LERF in 1995.
- The LERF basins are covered and all incoming air first passes through a breather filter.
- No precipitating or flocculating chemicals are used in flow and pH equalization.
- Multiple waste streams managed in a single LERF basin are evaluated for the formation of precipitates. Wastes that would form precipitates are not accepted for treatment at LERF.

Therefore, the residue component subject to this condition is the supernatant (liquid component). Additionally, an aqueous waste stream is evaluated for the potential to deposit solids in a LERF basin (i.e., an aqueous waste that contains suspended solids). If necessary, filtration at the waste source could be required before acceptance into LERF. Therefore, the residue component in LERF subject to this condition is the supernatant (liquid component). The contingency for removal of solids will be addressed during closure in Addendum H, Closure Plan.

The conditions of the treatment exemption also require that treatment residues (i.e., aqueous wastes), which do not meet the LDR treatment standards "must be removed at least annually" [40 CFR 268.4(a)(2)(ii) incorporated by reference by WAC 173-303-140]. To address the conditions of this exemption, an influent aqueous waste is sampled and analyzed and the LDR status of the aqueous waste is established as part of the acceptance process. The LERF basins are then managed such that any aqueous waste(s), which exceeds an LDR standard, is removed annually from a LERF basin, except for a heel of approximately 3 feet. A heel is required to stabilize the LERF liner. The volume of the heel is approximately 550,006 gallons.

B.4 Influent Aqueous Waste Sampling and Analysis

The following sections provide a summary of the sampling procedures, frequencies, and analytical parameters for characterization of influent aqueous waste (Section B.2) and in support of the special management requirements for aqueous waste in the LERF (Section B.3).

B.4.1 Sampling Procedures

With a few exceptions, generators are responsible for the characterization, including sampling and analysis, of an influent aqueous waste. Process condensate is either sampled at the 242-A Evaporator or accumulated in a LERF basin following a 242-A Evaporator campaign and sampled. Other exceptions will be handled on a case-by-case basis and the Hanford Facility Operating Record, LERF and 200 Area ETF File will be maintained at the unit for inspection by Ecology. The following section discusses the sampling locations, methodologies, and frequencies for these aqueous wastes. For samples collected at the LERF and 200 Area ETF, unit-specific sampling protocol is followed. The sample containers, preservation materials, and holding times for each analysis are listed in Section B.8.

B.4.1.1 Batch Samples

In those cases where an aqueous waste is sampled in a LERF basin, samples are collected from four of the six available sample risers located in each basin, i.e., four separate samples. When LERF levels are low, fewer than four samples can be taken if the sampling approach is still representative. Though there are eight sample risers at each basin, one is dedicated to liquid level instrumentation and another is dedicated as an influent port. Operating experience indicates that four samples adequately capture the spatial variability of an aqueous waste stream in the LERF basin. Specifically, sections of stainless steel (or other compatible material) tubing are inserted into the sample riser to an appropriate depth. Using a portable pump, the sample line is flushed with the aqueous waste and the sample collected. The grab sample containers typically are filled for volatile organic compounds (VOC) analysis first, followed by the remainder of the containers for the other parameters.

Several sample ports are also located at 200 Area ETF, including a valve on the recirculation line at 200 Area ETF surge tank, and a sample valve on a tank discharge pump line at the 2025-ED Load-In Station. All samples are obtained at the LERF or 200 Area ETF are collected in a manner consistent with SW-846 procedures (EPA as amended).

B.4.2 Analytical Rationale

As stated previously, each generator is responsible for designating and characterizing an aqueous waste stream. Accordingly, each generator samples and analyzes an influent waste stream using the target list of parameters (Table B.3) for the waste acceptance process. At the discretion of the LERF and 200 Area ETF management, a generator may provide knowledge in lieu of some analyses as discussed in Section B.2.1.1. The LERF and 200 Area ETF personnel will work with the generator to determine which parameters are appropriate for the characterization.

The analytical methods for these parameters are provided in Section B.8. All methods are EPA methods satisfying the requirements of WAC 173-303-110(3). Additional analyses may be required if historical information and knowledge indicate that an influent aqueous waste contains constituents not included in the target list of parameters. For example, if knowledge indicates that an aqueous waste contains a parameter that is regulated by the Groundwater Quality Criteria (WAC 173-200), that parameter(s) would be added to the suite of analyses required for that aqueous waste stream.

The analytical data for the parameters presented in Table B.3, including VOC, Semi-volatile Organic Compound (SVOC), metals, anions, and general chemistry parameters are used to define the physical and chemical properties of the aqueous waste for the following:

- Set operating conditions in the LERF and 200 Area ETF (e.g., to determine operating configuration, refer to Section B.2.2.2).
- Identify concentrations of some constituents which may also interfere with, or foul 200 Area ETF treatment process (e.g., fouling of the RO membranes, refer to Section B.2.2.2).
- Evaluate LERF liner and piping material compatibility.
- Determine treatability to evaluate if applicable constituents in the treated effluent will meet Discharge Permit and Delisting limits.
- Estimate concentrations of some constituents in the waste generated in the secondary treatment train (i.e., dry powder waste).

Table B.3. Target Parameters for Influent Aqueous Waste Analyses

VOLATILE ORGANIC COMPOUNDS	**SEMIVOLATILE ORGANIC COMPOUNDS**
Acetone	Acetophenone
Acetonitrile	Cresol (o, p, m)
Benzene	Dichloroisopropyl ether (bis(2-chloropropyl)ether)
1-Butanol	Di-n-octyl phthalate
Carbon disulfide	Diphenylamine
Carbon tetrachloride	Hexachlorobenzene
Chloroform	Hexachlorocyclopentadiene
Methylenechloride	Iosophorone
Tetrachloroethylene	Lindane (gamma-BHC)
Tetrahydrofuran	N-nitrosodimethylamine
	Pyridine
	Tributyl phosphate
	2,4,6-Trichlorophenol

TOTAL METALS		**ANIONS**
Arsenic	Magnesium	Chloride
Barium	Mercury	Fluoride
Beryllium	Nickel	Nitrate
Cadmium	Potassium	Nitrite
Calcium	Selenium	Phosphate
Chromium	Silicon	Sulfate
Copper	Silver	**GENERAL CHEMISTRY PARAMETERS**
Iron	Sodium	Ammonia
Lead	Vanadium	Cyanide
	Zinc	pH
		Total suspended solids
		Total dissolved solids
		Total organic carbon
		Specific conductivity

B.5 Treated Effluent Sampling and Analysis

The treated aqueous waste, or effluent, from 200 Area ETF is collected in three verification tanks before discharge to the SALDS. To determine whether the discharge limits, and the Final Delisting 200 Area ETF criteria are met, the effluent routinely is sampled at the verification tanks. The sampling and analyses performed are described in the following sections.

B.5.1 Rationale for Effluent Analysis Parameter Selection

The parameters measured in the treated effluent are required by the following regulatory documents:

- Delisting criteria from the Final Delisting 200 Area ETF (40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3)).
- Corresponding State Final Delisting issued pursuant to WAC 173-303-910(3).
- Effluent limits from the Discharge Permit Number ST0004500.

- The Final Delisting 200 Area ETF provides two testing regimes for the treated effluent. Initial verification testing is performed when a new influent waste stream is processed through the 200 Area ETF. For each 200 Area ETF influent waste stream, the first generated verification tank must be sampled and analyzed for all delisting constituents and conductivity. Subsequent verification sampling and analysis of all delisting parameters is performed on every 15th tank of that 200 Area ETF influent waste stream. If the concentration of any analyte is found to exceed a Discharge Permit Number ST0004500, enforcement limit or a Delisting criterion, the contents of the verification tank are reprocessed and/or re-analyzed. The next verification tank generated is also sampled for all delisting constituents.

B.5.2 Effluent Sampling Strategy: Methods, Location, Analyses, and Frequency

Effluent sampling methods and locations, the analyses performed, and frequency of sampling are discussed in the following sections.

B.5.2.1 Effluent Sampling Method and Location

Samples of treated effluent are collected and analyzed to verify the treatment process using 200 Area ETF specific sampling protocol. These verification samples are collected at a sampling port on the verification tank recirculation line. Section B.8 presents the sample containers, preservatives, and holding times for each parameter monitored in the effluent.

B.5.2.2 Analyses of Effluent

The parameters required by the current Discharge Permit Number ST0004500, and Final Delisting 200 Area ETF, conditions are presented in Table B.4. The analytical methods and PQLs associated with each parameter are provided in Section B.8. The methods and PQLs are equivalent to those used in the analysis of influent aqueous waste.

B.5.2.3 Frequency of Sampling

Treated effluent is tested for all parameters listed in Table B.4 on a frequency satisfying the permit conditions of the Discharge Permit Number ST0004500, and the Final Delisting 200 Area ETF. This effluent must meet the Discharge Permit Number ST0004500, and Final Delisting 200 Area ETF limits associated with these parameters. Grab samples are collected from each verification tank.

During operation of 200 Area ETF, if one or more of the constituents exceeds a Delisting criterion, the Delisting conditions require:

- The characterization data and processing strategy of the influent waste stream be reviewed and changed accordingly to ensure the contents of subsequent tanks do not exceed the Delisting criteria
- The contents of the verification tank are recycled for additional treatment. The contents that are recycled are resampled after treatment to ensure no constituents exceed a Delisting criteria
- The contents of the following verification tank are sampled for compliance with the Delisting criteria.
- Treated effluent that does not meet Discharge Permit Number ST0004500 is not discharged to the SALDS until the tank has been retreated and/or reanalyzed.

B.6 Effluent Treatment Facility Generated Waste Sampling and Analysis

The wastes discussed in this section include the wastes generated at 200 Area ETF and are managed in the container storage areas of 200 Area ETF. This section describes the characterization of the following secondary waste streams generated within 200 Area ETF:

- Secondary waste generated from the treatment process, including the following waste forms:
  - dry powder waste
  - concentrate tanks slurry

   - sludge removed from process tanks
- Waste generated by operations and maintenance activities
- Miscellaneous waste generated within 200 Area ETF

For each waste stream described, a characterization methodology and rationale are provided, and sampling requirements are addressed.

B.6.1 Secondary Waste Generated from Treatment Processes

The following terms used in this Section, including powder, dry powder, waste powder, and dry waste powder, are equivalent to the term 'dry powder waste'.

A dry powder waste is generated from the secondary treatment train, from the treatment of an aqueous waste. Waste is received in the secondary treatment train in waste receiving tanks where it is fed into an evaporator. Concentrate waste from the evaporator is then fed to a concentrate tank. From these tanks, the waste is fed to a thin film dryer and dried into a powder, and collected into containers. The containers are filled via a remotely controlled system. The condensed overheads from the evaporator and thin film dryer are returned to the surge tank to be fed to the primary treatment train.

Occasionally, salts from the treatment process (e.g., calcium sulfate and magnesium hydroxide) accumulate in process tanks as sludge. Because processing these salts could cause fouling in the thin film dryer, and to allow uninterrupted operation of the treatment process, the sludge is removed and placed in containers. The sludge is dewatered and the supernate is pumped back to 200 Area ETF for treatment.

The secondary treatment system typically receives and processes the following by-products generated from the primary treatment train:

- Concentrate from the first RO stage.
- Backwash from the rough and fine filters.
- Regeneration waste from the ion exchange system.
- Spillage or overflow collected in the process sumps.

In an alternate operating scenario, some aqueous wastes may be fed to the secondary treatment train before the primary treatment train.

B.6.1.1 Special Requirements Pertaining to Land Disposal Restrictions

Containers of 200 Area ETF secondary waste are transferred to a storage or final disposal unit, as appropriate (e.g., the Central Waste Complex or to the Environmental Restoration Disposal Facility). 200 Area ETF personnel provide the analytical characterization data and necessary knowledge for the waste to be managed by the receiving staff, and for the appropriate LDR documentation.

The following information on the secondary waste is included on the LDR documentation provided to the receiving unit:

- Dangerous waste numbers (as applicable).
- Determination on whether the waste is restricted from land disposal according to the requirements of 40 CFR 268 incorporated by reference by WAC 173-303-140 (i.e., the LDR status of the waste).

The waste tracking information associated with the transfer of waste

- Waste analysis results.

B.6.1.2 Sampling Methods

The dry powder waste and containerized sludge are sampled from containers using the principles presented in SW-846 (EPA as amended) and ASTM Methods (American Society for Testing Materials), as referenced in WAC 173-303-110(2). The sample container requirements, sample preservation requirements, and maximum holding times for each of the parameters analyzed in either matrix are presented in Section B.8.

Concentrate tank waste samples are collected from recirculation lines, which provide mixing in the tank during pH adjustment and prevent caking. The protocol for concentrate tank sampling prescribes opening a sample port in the recirculation line to collect samples directly into sample containers. The sample port line is flushed before collecting a grab sample. The VOC sampling typically is performed first for grab samples. Each VOC sample container will be filled such that cavitation at the sample valve is minimized and the container has no headspace. The remainder of the containers for the other parameters will be filled next.

Table B.4. Rationale for Parameters to be Monitored in Treated Effluent

Parameter	(Cas No.)	Final Delisting 200 Area ETF Delisting[1]	ST0004500 Discharge Permit[2] Effluent Limit
VOLATILE ORGANIC COMPOUNDS			
Acetone	(67-64-1)	X	X
Acetonitrile	(75-05-8)	X	
Benzene	(71-43-2)	X	X
1-Butanol	(71-36-3)	X	
Carbon disulfide	(75-15-0)	X	
Carbon tetrachloride	(56-23-5)	X	X
Chloroform	(67-66-3)		X
Methylene Chloride	(75-09-2)		M
Tetrachloroethylene	(127-18-4)		X
Tetrahydrofuran	(109-99-9)	X	X
SEMIVOLATILE ORGANIC COMPOUNDS			
Acetophenone	(98-86-2)		X
Carbazole	(86-74-8)	X	
p-Chloroaniline	(106-47-8)	X	
Chrysene	(218-01-9)	X	
Cresol (total)	(1319-77-3)	X	
Dichloroisopropyl ether (bis(2-chloroisopropyl)ether)	(108-60-1)	X	
Di-n-octyl phthalate	(117-84-0)	X	
Diphenylamine	(122-39-4)	X	
Hexachlorobenzene	(118-74-1)	X	
Hexachlorocyclopentadiene	(77-47-4)	X	
Isophorone	(78-59-1)	X	
Lindane (gamma-BHC)	(58-89-9)	X	
N-nitrosodimethylamine	(62-75-9)	X	X
Pyridine	(110-86-1)	X	
Tributyl phosphate	(126-73-8)	X	
2,4,6-Trichlorophenol	(88-06-2)	X	
PCBs			
Aroclor 1016	(12674-11-2)	X	

Table B.4. Rationale for Parameters to be Monitored in Treated Effluent			
Parameter	(Cas No.)	Final Delisting 200 Area ETF Delisting[1]	ST0004500 Discharge Permit[2] Effluent Limit
Aroclor 1221	(11104-28-2)	X	
Aroclor 1232	(11141-16-5)	X	
Aroclor 1242	(53469-21-9)	X	
Aroclor 1248	(12672-29-6)	X	
Aroclor 1254	(11097-69-1)	X	
Aroclor 1260	(11096-82-5)	X	
TOTAL METALS[3]			
Arsenic	(7440-38-2)	X	X
Barium	(7440-39-3)	X	
Beryllium	(7740-41-7)	X	X
Cadmium	(7440-43-9)	X	X
Chromium	(7440-47-3)	X	X
Copper	(7440-50-8)		X
Lead	(7439-92-1)	X	X
Mercury	(7439-97-6)	X	X
Nickel	(7440-02-0)	X	
Selenium	(7782-49-2)	X	
Silver	(7440-22-4)	X	
Vanadium	(7440-62-2)	X	
Zinc	(7440-66-6)	X	
ANIONS			
Chloride	(16887-00-6)		X
Fluoride	(16984-48-8)	X	
Nitrate (as N)	(14797-55-8)		X
Nitrite (as N)	(1479765-0)		X
Sulfate	(14808-79-8)		X
OTHER ANALYSES			
Ammonia	(7664-41-7)	X	X
Cyanide	(57-12-5)	X	
Total dissolved solids			X
Total organic carbon			X
Total suspended solids			X
Specific conductivity			M

[1] Parameters required by the current conditions of the Final Delisting 200 Area ETF, 40 CFR 261, Appendix IX, Table 2 incorporated by reference by WAC 173-303-910(3),70 FR 44496 (EPA 2005)

[2] Parameters required by the current conditions of the Discharge Permit Number ST0004500

[3] Metals reported as total concentrations

X = Rationale for measuring this parameter in treated effluent

M = Monitor only; no limit defined

PCBs = polychlorinated biphenyls

B.6.1.3 Sampling Frequency

When designation or identification of applicable LDR treatment standards of the 200 Area ETF secondary waste cannot be based on influent characterization data or knowledge as described in Section B.6.1.1, 200 Area ETF secondary waste is sampled on a batch basis. A batch is defined as any volume of aqueous waste that is being treated under consistent and constant process conditions.

When personnel exposures are of concern, one representative sample will be collected from the concentrate tank, if waste from the concentrate tank. The sample will be analyzed for the appropriate parameters identified in Table B.5 based on the needs identified from evaluating influent waste analysis data. If sampling of the concentrate tank is not technically practicable for purposes of designating the powder, direct sampling of the dry powder will be used to make determinations on the dry powder. The dry powder or concentrate tanks will be resampled in the following situations:

- Change in influent characterization.
- Change in process chemistry, as indicated by in-line monitoring of conductivity and pH.
- The LERF and 200 Area ETF management have been notified, or have reason to believe that the process generating the waste has changed (for example, a source change such as a change in the well-head for groundwater that significantly changes the aqueous waste characterization).
- The LERF and 200 Area ETF management note an increase or decrease in the concentration of a constituent in an aqueous waste stream, beyond the range of concentrations that was described or predicted in the waste characterization.

B.6.2 Operations and Maintenance Waste Generated at the 200 Area Effluent Treatment Facility

Operation and maintenance of process and ancillary equipment generates additional routine waste. These waste materials are segregated to ensure proper handling and disposition, and to minimize the commingling of potentially dangerous waste with nondangerous waste. The following waste streams are anticipated to be generated during routine operation and maintenance of 200 Area ETF. This waste might or might not be dangerous waste, depending on the nature of the material and its exposure to a dangerous waste.

- Spent lubricating oils and paint waste from pumps, the dryer rotor, compressors, blowers, and general maintenance activities
- Spent filter media and process filters
- Spent ion exchange resin
- High Efficiency Particulate Air (HEPA) filters
- UV light tubes
- RO membranes
- Equipment that cannot be returned to service
- Other miscellaneous waste that might contact a dangerous waste (e.g., plastic sheeting, glass, rags, paper, waste solvent, or aerosol cans)

These waste streams are stored at 200 Area ETF before being transferred for final treatment, storage, or disposal as appropriate.

This waste is characterized and designated using knowledge (from previously determined influent aqueous waste composition information); analytical data; and material safety data sheets (MSDS) of the chemical products present in the waste or used (the data sheets are maintained at 200 Area ETF). Sampling of these waste streams is not anticipated; however, if an unidentified or unlabeled waste is discovered, that waste is sampled. This 'unknown' waste is sampled and analyzed for the parameters in

Table B.5 as appropriate, and will be designated according to Washington state regulatory requirements. The specific analytical methods for these analyses are provided in Section B.8.

B.6.3 Other Waste Generated at the 200 Area Effluent Treatment Facility

There are two other potential sources of waste at 200 Area ETF: spills and/or overflows, and discarded chemical products. Spills may be subject to the requirements of Permit Condition II.E. Spilled material that potentially might be dangerous waste generally is either containerized or routed to 200 Area ETF sumps where the material is transferred either to the surge tank for treatment or to the secondary treatment train. In most cases, knowledge and the use of MSDSs are sufficient to designate the waste material. If the source of the spilled material is unknown and the material cannot be routed to 200 Area ETF sumps, a sample of the waste is collected and analyzed according to Table B.5, as necessary, for appropriate characterization of the waste. Unknown wastes will be designated according to Washington State regulatory requirements at WAC 173-303-070. The specific analytical methods for these analyses are provided in Section B.8.

A discarded chemical product waste stream could be generated if process chemicals, cleaning agents, or maintenance products become contaminated or are otherwise rendered unusable. In all cases, these materials are appropriately containerized and designated. Sampling is performed, as appropriate, for waste designation.

Table B.5. 200 Area Effluent Treatment Facility Generated Waste - Sampling and Analysis

Parameter[1]	Rationale
• Total solids or percent water[2]	• Calculate dry weight concentrations
• Volatile organic compounds[3]	• LDR - verify treatment standards
• Semi-volatile organic compounds[3]	• LDR - verify treatment standards
• Metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver)	• Waste designation • LDR - verify treatment standards
• Cation and anions of concern	• Address receiving TSD unit waste acceptance requirements
• pH	• Waste designation

[1] For influent and concentrate tank samples, the total sample (solid plus liquid) is analyzed and the analytical result is expressed on a dry weight basis. The result for toxicity characteristic metal and organic is divided by a factor of 20 and compared to the toxicity characteristic (TC) constituent limits [WAC 173-303-090(8)]. If the TC limit is met or exceeded, the waste is designated accordingly. All measured parameters are compared against the corresponding treatment standards.

[2] Total solids or percent water are not determined for unknown waste and dry powder waste samples and are analyzed in maintenance waste and sludge samples, as appropriate (i.e., percent water might not be required for such routine maintenance waste as aerosol cans, fluorescent tubes, waste oils, batteries, etc., or sludge that has dried).

[3] VOC and/or SVOC analysis of secondary waste is required unless influent characterization data and knowledge indicate that the constituent will not be in the final secondary waste at or above the LDR.

LDR = land disposal restrictions

TSD = treatment, storage, and/or disposal

B.7 Quality Assurance/Quality Control

The following quality assurance/quality control (QA/QC) plan for LERF and 200 Area ETF is provided as required by WAC 173-303-810(6) and follows the guidelines of EPA QA/G-5.

B.7.1 Project Management

The following sections address project administrative functions and approaches.

B.7.1.1.1 Project Organization

Overall management of the LERF and 200 Area ETF is performed by the Facility Manager, who is responsible for safe operation of the facility, including implementation of this QA/QC plan and compliance with applicable permits and regulations. The Facility Manager also provides retention of project records in accordance with this plan. Assisting the Facility Manager is an Environmental Field Representative that monitors compliance, reviews new requirements and regulations, and interfaces with EPA and Ecology. Also assisting the Facility Manager is a QA representative who is responsible for implementing the QA program at the facility.

Reporting to the Facility Manager are several support groups. The Operations group consists of trained personnel who operate the plant, including operators performing sampling activities such as collection, packaging, and transportation of samples to the laboratory. The Maintenance group is responsible for performing calibrations and preventative maintenance on facility equipment, including pH, conductivity, and flow meters required by environmental permits. The Engineering group monitors the process with online instruments and sampling for process control. The Engineering group also performs waste acceptance, and environmental compliance activities, including scheduling sampling, generating data forms, and reviewing data.

B.7.1.2 Special Training

Individuals involved in sampling, analysis, and data review will be trained and qualified to implement safely the activities addressed in this WAP and QA/QC plan. Training will conform to the training requirements specified in WAC 173-303-330 and Addendum F, Personnel Training. Training records will be maintained in accordance with Section B.7.1.3.

B.7.1.3 Documentation and Records

Sample records are documented as part of the Hanford Facility Operating Record, LERF and 200 Area ETF File pursuant to Permit Condition II.I. These documents and records include the following:

- Training
- Chains of Custody for all regulatory sampling performed by LERF and 200 Area ETF
- Data Summary Reports
- QA/QC reports
- Assessment reports
- Instrument inspection, maintenance, and calibration logs

B.7.2 Data Quality Parameters and Criteria

Data quality parameters are listed by EPA QA/G-5S, *Guidance for Choosing a Sampling Design for Environmental Data Collection* as:

- Purpose of Data Collection (e.g. determining if a parameter exceeds a threshold level).
- Spatial and Temporal Boundaries of Study.
- Preliminary Estimation of Sample Support (volume that each sample represents).
- Statistical Parameter of Interest (e.g. mean, percentile, percentage).
- Limits on Decision Error/Precision (e.g. false acceptance error, false rejection error).

The parameters for the first four bullets (limits, sample points, frequency of samples, etc.) are already established in the permits, delisting petition, and this WAP. The focus of this QA/QC plan is on limits on decision error/precision.

The data quality parameters were chosen to ensure Limits on Decision Error/Precision are appropriate for purposes of using the data to demonstrate compliance with permits, delisting exclusion limits, and this WAP. The principal quality parameters are precision, accuracy, representativeness, comparability, and completeness. Secondary data parameters of importance include sensitivity and detection levels. The data quality parameters and the data acceptance criteria are discussed below.

B.7.2.1 Precision

Precision is a measure of agreement among replicate measurements of the same property, under prescribed similar conditions. Precision is expressed in terms of the relative percent difference (RPD) for duplicate measurements. QA/QC sample types that test precision include field and laboratory duplicates and spike duplicates. The RPDs for laboratory duplicates and/or matrix spike duplicates will be routinely calculated.

$$\text{RPD} = (100)\textit{absolute value of}\left(\frac{\text{sample result} - \text{duplicate sample result}}{\text{average of sample result} + \text{duplicate sample result}}\right).$$

Matrix spike duplicates are replicates of matrix spike samples that are analyzed with every analytical batch that contains a 200 Area ETF treated effluent sample. The precision of the analytical methods are estimated from the results of the matrix spike (MS) and the matrix spike duplicate (MSD) for selected analytes. Matrix spike analyses cannot be performed for certain analytical methods, including conductivity, pH, and total dissolved solids. Duplicate analyses are used to determine the RPD for these methods. The precision acceptance criteria are specified in Table B.6.

B.7.2.2 Accuracy

Accuracy assesses the closeness of the measured value to an accepted reference value. Accuracy of analytical results is typically assessed using matrix spikes. A matrix spike is the addition of a known amount of the analyte to the sample matrix being analyzed. Accuracy is expressed as a percent recovery of the spiked samples.

$$\text{Percent Recovery} = 100\left(\frac{\text{matrix spike sample result} - \text{sample result}}{\text{spiked amount}}\right)$$

Matrix spike analyses cannot be performed on certain analytical methods, including conductivity, pH, and total dissolved solids. The percent recovery for the laboratory control standard samples demonstrates that these methods are working properly and gives an estimate of the method's accuracy. The percent recovery will be routinely calculated.

Accuracy criteria are established to provide confidence that the result is below the action level. Therefore the closer the result is to the action level the higher the degree of accuracy needed. The upper and lower accuracy acceptance criteria are specified in Table B.6. The criteria are reasonable values based on previous analysis of constituents in the delisting exclusion, or similar constituents.

B.7.2.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent selected characteristics of a parameter at a sampling point or process condition. Because of the matrix being analyzed, dilute aqueous solution, it is not expected that representativeness will be of concern, except when there are potential for changes to process conditions such as the facility influent concentrations or waste processing strategy. Sampling due to these changes in process conditions is addressed in Section B.6.1.3.

The representativeness of a sample may be compromised by the presence of contaminants introduced in the field or the laboratory. To determine if contamination may be present, a blank sample of reagent water is analyzed. A method blank is performed by the laboratory on every batch of 20 samples being analyzed at the same time. The presence of a constituent in the sample and the blank sample indicates contamination has occurred.

B.7.2.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system, expressed as a percentage of the number of valid measurements that were planned to be collected. Lack of completeness is sometimes caused by loss of a sample, loss of data, or inability to collect the planned number of samples. Incompleteness also occurs when data are discarded because they are of unknown or unacceptable quality. Since most regulatory sampling events performed by LERF and 200 Area ETF involve a single sample, all analysis must be complete and valid.

B.7.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another. Comparability is achieved by using sampling and analytical techniques, which provide for measurements that are consistent and representative of the media and conditions measured. In laboratory analysis, the term comparability focuses on method type, holding times, stability issues, and aspects of overall analytical quantitation.

B.7.2.6 Sensitivity and Detection Levels

Sensitivity is the measure of the concentration at which an analytical method can positively identify and report analytical results. Sensitivity represents the maximum value for a detection level that will reasonably assure the results are below the established limits. The analytical method selected by LERF and 200 Area ETF should have a detection level for each constituent that is below the sensitivity. The preferred detection level is the practical quantitation limit (PQL), which is lowest concentration that can be reliably measured during routine laboratory conditions. If the method PQL cannot meet the sensitivity for some constituents, the minimum concentration or attribute that can be measured by a method (method detection limit) or by an instrument (instrument detection limit) may be used. The sensitivity levels, specified in Table B.6, are derived from the delisting limits, water discharge limits, and uncertainty values, which are based on the required precision and accuracy for each constituent.

B.7.3 Data Generation and Acquisition

The following section addresses QA requirements for data generation and acquisition.

B.7.3.1 Sampling Method

LERF and 200 Area ETF samples required by the permits and delisting are collected as grab samples. Sampling for the purpose of waste designation of secondary waste is performed using grab, composite, thief, scoop, or composite liquid waste sampler (COLIWASA). The selection of the sample collection device depends on the type of sample, the sample container, the sampling location, and the nature and distribution of the waste components. In general, the methodologies used for specific materials correspond to those referenced to WAC 173-303-110(2). The selection and use of the sampling device is supervised or performed by a person thoroughly familiar with the sampling requirements.

The following protocol applies to all sampling methods:

- All containers will be filled within as short a time period as reasonably achievable.
- Volatile Organic Analysis (VOA) sample containers will be filled first, and prior to any subdividing of a composited sample.
- VOA samples consisting of a set of two or more sample containers will be filled sequentially. The sample containers are considered equivalent and given identical sampling times.
- All VOA sample containers must have no headspace and be free of trapped air bubbles.

- Grab sample protocol includes:
  - Sample lines should be as short as reasonably achievable and free of traps and pockets in which solids might settle.
  - The sample line should be flushed before sampling with a minimum volume equivalent to three times the sample line volume.
  - Contamination to the sample from contact with the internal and external surfaces of the tap should be minimized.

Thief and COLIWASA samplers are used to sample liquid waste containers such as drums. Scoop samplers are used to sample powder waste generated in the thin-film dryer. Sample requirements for these samples include:

- Thief or COLIWASA sampler, the sampler should be lowered into the liquid slowly so the level of the liquid inside and outside the sampler tube remain about the same.
- When lifting the thief or COLIWASA sampler from the solution, the outside should be wiped down, or the excess water allowed to drip off, before filling the sample container.

B.7.3.2 Sample Handling, Custody, and Shipping

The proper handling of sample bottles after sampling is important to ensure the samples are free of contamination and to demonstrate the samples have not been tampered with.

B.7.3.2.1 Chain-of-Custody

Evidence of collection, shipment, receipt at the laboratory, and laboratory custody until disposal will be documented using a chain-of-custody form. The chain-of-custody form will, as a minimum identify sample identification number, sampling date and time, sampling location, sample bottle type and number, analyses to be performed, and preservation method.

The operations person who signs as the collector on the chain of custody is the first custodian of the samples. A custodian must maintain continuous custody of sample containers at all times from the time the sample is taken until delivery to the laboratory or until delivery to a common carrier for shipment to an off-site location. Custody is maintained by any of the following:

- The custodian has the samples in view, or has placed the samples in locked storage, or keeps the samples within a secured area (e.g., controlled by authorized personnel only), or has applied a tamper-indicating device, such as evidence tape, to the sample containers or shipping containers.
- The custodian has taken physical possession of the samples or the shipping containers sealed with an intact tamper-indicating device, such as evidence tape.

B.7.3.2.2 Sample Preservation, Containers, and Holding Time

Table B.6 lists the sample container, preservation method, and holding time requirements for different types of analyses. These parameters are based on the requirements of 40 CFR 136, Table II.

B.7.3.3 Instrument Calibration and Preventive Maintenance

LERF and 200 Area ETF uses instruments to monitor operations and meet regulatory requirements. This includes continuous pH and conductivity monitors required by facility permits and delisting. All instruments are calibrated according to frequencies and tolerances established by the LERF and 200 Area ETF engineering group. Calibrations and other maintenance actions are scheduled and tracked by LERF and 200 Area ETF maintenance group using a preventive maintenance database. Measuring and test equipment used for instrument calibration is controlled, calibrated at specified intervals, and maintained to establish accuracy limits.

B.7.4 Assessment and Oversight

Quality programs can only be effective if meaningful assessments are performed to monitor and respond to issues associated with program performance. Routine assessment of data is performed as part of the validation process discussed in Section B.7.5.1.

B.7.4.1 Assessments and Response

Management assessments are conducted by first line management and subject matter experts, focusing on procedural adequacy, compliance, and overall effectiveness of the program. Management assessments of the sample program typically include the LERF and 200 Area ETF QA representative. Each management assessment has a performance objective or lines of inquiry. Examples may include personnel training, proper performance of sample custody, or completeness of sampling records.

B.7.4.2 Reports to Management

Results of performance assessments, including any issues identified, are provided to the LERF and 200 Area ETF Facility Manager in a written report. The Facility Manager is responsible to correct all findings from the report.

B.7.5 Verification and Validation of Analytical Data

The data verification and validation processes will ensure that the data resulting from the selected analytical method are consistent with requirements specified in this QA/QC plan.

B.7.5.1 Data Verification

The primary data reporting will be by electronic data systems. Data verification will be performed on laboratory data packages that support environmental compliance to ensure that their content is complete and in order. A review of the data package will be performed to ensure that:

- The data package contains the required technical information.
- Deficiencies are identified and documented.
- Identified deficiencies are corrected by the laboratory and the appropriate revisions are made.
- Deficient pages are replaced with the laboratory corrections.
- A copy of the completed verification report is placed in the data file.

B.7.5.2 Data Validation

Data validation ensures that the data resulting from analytical measurements meet the quality requirements specified in the QA/QC plan. Data validation will be performed on data packages that support environmental compliance.

The following are included in data validation:

- Chain-of-Custody (COC) – Verify the COC shows unbroken custody from sampling through receipt at the laboratory.
- Request analysis – Review the sample results to verify the requested analysis was performed. If an alternate method was used, verify permit-required detection limits were met.
- Holding times – Review the sample results to verify the analyses were performed within required holing times and where applicable, extraction times.
- Blank – Review the results of trip, field, and equipment blank samples to verify the sample results are not compromised by contamination.
- Laboratory QC – Verify the laboratory QC was completed and there are no outstanding problems.

B.8 Analytical Methods, Sample Containers, Preservative Methods, and Holding Times

Table B.6. Sample and Analysis Criteria for Influent Aqueous Waste and Treated Effluent

Parameter	Analytical Method[1]	Method PQL Sensitivity[2]	Accuracy/ Precision for Method[3] (percent)	Sample container[4]/ Preservative[4]/ Holding time[5]
VOLATILE ORGANIC COMPOUNDS				
Acetone	SW-846 8260 or EPA-600 624	40	60-120 / 20	Sample container 3 x 40-mL amber glass with septum Preservative HCl to pH<2; 4°C Holding time 14 days
Acetonitrile		820	60-120 / 20	
Benzene		5	60-120 / 20	
1-Butanol		1600	60-120 / 20	
Carbon Disulfide		1500	60-120 / 20	
Carbon tetrachloride		5	60-120 / 20	
Chloroform		5	50-130 / 20	
Methylene chloride		5	50-150 / 20	
Tetrachloroethylene		5	65-140 / 20	
Tetrahydrofuran		100	60-120 / 20	
SEMIVOLATILE ORGANIC COMPOUNDS				
Acetophenone	SW-846 8270 or EPA-600 625	10	70-110 / 25	Sample container 4 x 1-liter amber glass Preservative 4°C Holding time 7 days for extraction; 40 days for analysis after extraction
Carbazole		110	50-120 / 25	
p-Chloroaniline		76	50-120 / 25	
Chrysene		350	50-120 / 25	
Cresol (o, p, m)		760	50-120 / 25	
Di-n-octyl phthalate		300	50-120 / 25	
Diphenylamine		350	50-120 / 25	
Hexachlorobenzene		2	50-120 / 25	
Hexachlorocyclopentadiene		110	50-120 / 25	

Table B.6. Sample and Analysis Criteria for Influent Aqueous Waste and Treated Effluent

Parameter	Analytical Method[1]	Method PQL Sensitivity[2]	Accuracy/ Precision for Method[3] (percent)	Sample container[4]/ Preservative[4]/ Holding time[5]
Isophorone		2600	50-120 / 25	
Lindane (gamma-BHC)		1.9	50-120 / 25	
N-nitrosodimethylamine		10	50-120 / 25	
Pyridine		15	50-120 / 25	
Tributyl phosphate		76	50-120 / 25	
2.4.6-Trichlorophenol		230	50-120 / 25	
POLYCHLORINATED BIPHENYLs (PCBs)				
Aroclor-1016	SW-846 8082	0.4	50-110 / 25	Sample container 4 x 1-liter amber glass Preservative 4°C Holding time 1 year for extraction; 1 year for analysis after extraction
Aroclor-1221		0.4	50-110 / 25	
Aroclor-1232		0.4	50-110 / 25	
Aroclor-1242		0.4	50-110 / 25	
Aroclor-1248		0.4	50-110 / 25	
Aroclor-1254		0.4	50-110 / 25	
Aroclor-1260		0.4	50-110 / 25	
TOTAL METALS				
Arsenic	EPA-600 200.8	11	70-130 / 20	Sample container 1 x 0.5-liter plastic/glass Preservative 1:1 HNO_3 to pH<2 Holding time 180 days; mercury 28 days
Beryllium		34	75 - 125 / 20	
Cadmium		5	70-130 / 20	
Chromium		20	70-130 / 20	
Copper		70	70-130 / 20	
Lead		10	70-130 / 20	

Table B.6. Sample and Analysis Criteria for Influent Aqueous Waste and Treated Effluent

Parameter	Analytical Method[1]	Method PQL Sensitivity[2]	Accuracy/ Precision for Method[3] (percent)	Sample container[4]/ Preservative[4]/ Holding time[5]
Selenium		20	70-130 / 20	
Barium	SW-846 6010/ EPA-600 200.7	1200	75 - 125 / 20	
Calcium		200	75 - 125 / 20	
Iron		100	75 - 125 / 20	
Magnesium		400	75 - 125 / 20	
Nickel		340	75 - 125 / 20	
Potassium		10,000	75 - 125 / 20	
Silicon		580	75 - 125 / 20	
Silver		83	75 - 125 / 20	
Sodium		2500	75 - 125 / 20	
Vanadium		120	75 - 125 / 20	
Zinc		5100	75 - 125 / 20	
Mercury	SW-846 7470, or EPA-600 245 .1	2	70-130 / 20	
GENERAL CHEMISTRY				
Chloride	EPA-600 300.0	1000	70-130 / 20	<u>Sample container</u> 1 x 60-mL plastic/glass <u>Preservative</u> 4°C <u>Holding time</u> 28 days; nitrate and nitrite 48 hours
Fluoride		880	70-130 / 20	
Formate		1250	70-130	
Nitrate (as N)		100	70-130 / 20	
Nitrite (as N)		100	70-130 / 20	
Phosphate		1500	70-130 / 20	
Sulfate		10,000	70-130 / 20	
Ammonia (as N)	EPA-600, 300.7, or EPA-600 350 .1	40	70-130 / 20	<u>Sample container</u> 1 x 50-mL glass or plastic <u>Preservative</u> H_2SO_4 to pH<2; 4°C <u>Holding time</u> 28 days

Table B.6. Sample and Analysis Criteria for Influent Aqueous Waste and Treated Effluent

Parameter	Analytical Method[1]	Method PQL Sensitivity[2]	Accuracy/ Precision for Method[3] (percent)	Sample container[4]/ Preservative[4]/ Holding time[5]
Cyanide	EPA-600 335.2/335.3	350	70-130 / 20	Sample container 1 x 250-mL glass or plastic Preservative NaOH to pH>12; 4°C Holding time 14 days
Alkalinity	EPA-600 310.1/310.2	ND	ND	Sample container 1 x 50-mL glass or plastic Preservative 4°C Holding time 14 days
Total dissolved solids	EPA-600 160.1 or SM2540C	ND	ND	Sample container 1 x 500-mL glass or plastic Preservative 4°C Holding time 7 days
Total suspended solids	EPA-600 160.2 or SM2540D	ND	ND	Sample container 1 x 1-L glass or plastic Preservative 4°C Holding time 7 days
Specific conductivity	EPA-600 120.1 (in lab) or SM2510B	ND	ND	Sample container 1 x 50-mL glass or plastic Preservative 4°C Holding time 28 days

Table B.6. Sample and Analysis Criteria for Influent Aqueous Waste and Treated Effluent

Parameter	Analytical Method[1]	Method PQL Sensitivity[2]	Accuracy/ Precision for Method[3] (percent)	Sample container[4]/ Preservative[4]/ Holding time[5]
pH[7]	EPA-600 150.1 or SM4500-H^+B	ND	ND	<u>Sample container</u> 1 x 60-mL glass or plastic <u>Preservative</u> None <u>Holding time</u> Analyze immediately
Total organic carbon	SW-846 9060 or SMC5310	ND	ND	<u>Sample container</u> 1 x 250-mL amber glass <u>Preservative</u> H_2SO_4 to pH<2; 4°C <u>Holding time</u> 28 days

[1] SW-846 or EPA-600 methods are presented unless otherwise noted. Other methods might be substituted if the applicable PQL can be met.

[2] ST0004500 required method PQL or Delisting Exclusion condition 2 report sensitivity/detection level, whichever is lower. Units are parts per billion unless otherwise noted.

[3] Accuracy/precision used to confirm or re-establish MDL

[4] Sample bottle, volumes, and preservatives could be adjusted, as applicable, for safety reasons

[5] Holding time = time between sampling and analysis

[7] pH monitored in influent aqueous waste only

NA = not applicable
ND = not determined
MDL = method detection level
PQL = practical quantitation limit
RL = reporting limit

Table B.7. Sample Containers, Preservative Methods, and Holding Times for 200 Area ETF Generated Waste

Parameter	Analytical Method[1]	Method PQL	Accuracy/ Precision for Method (percent)	Sample container[2]/ Preservative[2]/ Holding time[3]
Liquid Matrix				
For methods other than total solids, analyze using the methods and QA/QC in Table B.6. For each method, analyze the target compound list				
Total solids	EPA-600 160.3	ND	ND	Sample container 1 x 500-mL glass or plastic Preservative – 4°C Holding time –7 days
Solid Matrix				
Volatile organic compounds (combined method target compound lists)	SW-846 8260	Refer to Table B.6	Refer to Table B.6	Sample container 1 x 40-mL amber glass with septum Preservative –4°C Holding time –14 days
Semi-volatile organic compounds (method target compound list)	SW-846 8270	Refer to Table B.6	Refer to Table B.6	Sample container 1 x 125-mL amber glass Preservative –4°C Holding time –14 days for extraction; 40 days for analysis after extraction
PCBs (method target compound list)	SW-846 8082	Refer to Table B.6	Refer to Table B.6	Sample container Amber glass – 50 g of sample Preservative –4°C Holding time –1 year for extraction; 1 year for analysis after extraction
RCRA Metals (method target compound list)	EPA-600 200.8	Refer to Table B.6	Refer to Table B.6	Sample container glass or plastic – 10 g of sample Preservative –none, mercury 4°C Holding time –180 days; mercury 28 days
Total Metals (method target compound list)	SW-846 6010	Refer to Table B.6	Refer to Table B.6	
Anions (method target compound list)	EPA-600 300.0	Refer to Table B.6	Refer to Table B.6	Sample container glass or plastic –25 g of sample Preservative –none Holding time –6 months for extraction; 28 days for analysis after extraction, nitrate and nitrite 48 hours for analysis after extraction

Table B.7. Sample Containers, Preservative Methods, and Holding Times for 200 Area ETF Generated Waste

Parameter	Analytical Method[1]	Method PQL	Accuracy/ Precision for Method (percent)	Sample container[2]/ Preservative[2]/ Holding time[3]
Ammonia	EPA-600 300.7	Refer to Table B.6	Refer to Table B.6	Sample container glass or plastic – 25 g of sample Preservative –none Holding time –6 months for extraction; 28 days for analysis after extraction
pH	SW-846 9045	ND	ND	Sample container glass or plastic – 50 g of sample Preservative –none Holding time –none
Toxicity Characteristic Leaching Procedure[4]	SW-846 1311	NA	NA	Sample container Refer to specific method being performed after TCLP – 125 g of sample Preservative –None (after TCLP, preserve extract per method being performed) Holding time –Metals: 180 days for TCLP extraction, mercury 28 days for TCLP extraction SVOA: 14 days for TCLP extraction (after TCLP, refer to specific methods for time for analysis after extraction)

[1] SW 846 or EPA-600 methods are presented unless otherwise noted. Other methods might be substituted if the applicable PQL can be met.

[2] Sample bottle, volumes, and preservatives could be adjusted, as applicable, for safety reasons

[3] Holding time equals time between sampling and analysis

[4] Extraction procedure, as applicable; extract analyzed by referenced methods [WAC 173-303-110(3)(c)]

NA = not applicable

PQL = practical quantitation limit

ND = not determined

TCLP = toxicity characteristic leaching procedure

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LIQUID EFFLUENT RETENTION FACILITY (LERF) & 200 AREA EFFLUENT TREATMENT FACILITY (ETF) ADDENDUM C PROCESS INFORMATION

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/25/2017	8C.2017.3F
08/25/2016	8C.2016.Q2

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ADDENDUM C
PROCESS INFORMATION

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C. PROCESS INFORMATION

This addendum provides a detailed discussion of the Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (200 Area ETF) processes and equipment. The LERF and 200 Area ETF comprise an aqueous waste treatment system located in the 200 East Area that provides storage and treatment for a variety of aqueous mixed waste. This aqueous waste includes process condensate from the 242-A Evaporator and other aqueous waste generated from onsite remediation and waste management activities.

The LERF consists of three lined surface impoundments, or basins. Aqueous waste from LERF is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State-Approved Land Disposal Site (SALDS) north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit ST0004500 and the Final Delisting 200 Area ETF (40 CFR 261, Appendix IX, Table 2).

Both LERF and 200 Area ETF waste processing operations are controlled in a central Control Room located in the 2025-E building. The 200 Area ETF Control Room is staffed continuously during 200 Area ETF processing operations. Processing operations are defined as when liquid transfers of any sort are occurring to/from/within the LERF and 200 Area ETF or when wastes are being treated at 200 Area ETF[1]. Examples of processing operations include, but are not limited to, when liquid waste are transferred to/from the LERF basins [see section C.1], during active liquid waste treatment/processing at the 200 Area ETF (e.g., liquid waste treatment in tanks and liquid waste movement between primary and secondary treatment train processes and/or other 200 Area ETF tanks [see Section C.2], and liquid waste receipts at the Load-In Station [see Section C.2.1]). Section C.2.5.1 describes the centralized computer system (i.e., monitor and control system or MCS) that is located at the 200 Area ETF Control Room and other locations at the 200 Area ETF. The MCS monitors the performance of the 200 Area ETF operations and records alarms from various equipment as described in this Addendum C and Addendum I, Inspection Requirements. At times when processing operations are not occurring, the 200 Area ETF Control Room is not manned continuously, and alarms are monitored daily as specified in Addendum I.

The hazardous waste management activities for each dangerous waste management unit (DWMU) are identified in Table C.1 and Addendum A, Part A Form. Storage containers can be moved between the DWMUs identified in Table C.1 to support LERF and 200 Area ETF waste management processes. Additional information on waste generation and designation is provided in Section B.6. The waste streams are stored and some are treated at 200 Area ETF before being transferred for final treatment, storage, or disposal as appropriate.

[1]*Liquid transfers does not include standard facility operations of liquid recirculation (e.g. for pump seals), sanitary water and cooling water, and outdoor rainwater management activities.*

Table C.1. Summary of LERF and 200 Area Dangerous Waste Management Units

Management Type	DWMUs	Part A Treatment	Part A Storage
Surface Impoundment (storage and treatment)	1. LERF Basin 42 2. LERF Basin 43 3. LERF Basin 44	T02 Surface Impoundment Treatment	S04 Surface Impoundment Storage
Container (storage and treatment)	1. 2025-E Container Storage Area 2. 2025-E Process Area 3. 2025-E Truck Bay 4. Outside Container Storage Area 5. 2025-ED Load-In Station	T04 Container Treatment	S01 Container Storage
Tank (storage and treatment)	1. 20B-TK-1, Sump Tank 1 2. 20B-TK-2, Sump Tank 2 3. 59A-TK-1, Load-In Station Tank 4. 59A-TK-109, Load-In Station Tank (permanently removed from service) 5. 59A-TK-117, Load-In Station Tank (permanently removed from service) 6. 60A-TK-1, Surge Tank 7. 60C-TK-1, pH Adjust Tank 8. 60C-TK-2, Effluent pH Adjust Tank 9. 60F-TK-1, 1st RO Feed Tank 10. 60F-TK-2, 2nd RO Feed Tank 11. 60H-TK-1A, Verification Tank 12. 60H-TK-1B, Verification Tank 13. 60H-TK-1C, Verification Tank 14. 60I-EV-1, Evaporator Vapor Body Vessel 15. 60I-TK-1A, Secondary Waste Receiving Tank 16. 60I-TK-1B, Secondary Waste Receiving Tank 17. 60I-TK-2, Distillate Flash Tank 18. 60J-TK-1A, Concentrate Tank 19. 60J-TK-1B, Concentrate Tank	T01 Tank Treatment	S02 Tank Storage

The following sections provide a description of each of the authorized DWMUs within the LERF and 200 Area ETF.

C.1 Liquid Effluent Retention Facility Process Description

Each of the three LERF basins has an operating capacity of 7.8 million gallons. The LERF receives aqueous waste through several inlets including the following:

- A pipeline that connects LERF with the 242-A Evaporator.
- A pipeline from the 200 West Area.
- A pipeline that connects LERF to the Load-In Station (2025-ED).
- A series of sample ports located at each basin.

Figure C.1 presents a general layout of LERF and associated pipelines. Aqueous waste from LERF is pumped to the 200 Area ETF through one of two double-walled fiberglass transfer pipelines. Effluent from the 200 Area ETF also can be transferred back to the LERF through one of these transfer pipelines. These pipelines are equipped with leak detection located in the annulus between the inner and outer pipes. In the event that these leak detectors are not in service, the pipelines are visually inspected during transfers for leakage by opening the secondary containment drain lines located at the 200 Area ETF end of the transfer pipelines.

Each basin is equipped with six available sample risers constructed of 6-inch perforated pipe. A seventh sample riser in each basin is dedicated to influent aqueous waste receipt piping (except for aqueous waste received from the 242-A Evaporator), and an eighth riser in each basin contains liquid level instrumentation.

Each riser extends along the sides of each basin from the top to the bottom of the basin and allows samples to be collected from any depth. Personnel access to these sample ports is from the perimeter area of the basins. A catch basin is provided at the northwest corner of each LERF basin for aboveground piping and manifolds for transfer pumps. Aqueous waste from the 242-A Evaporator is transferred through piping which ties into piping at the catch basins. Under routine operations, a submersible pump is used to transfer aqueous waste from a LERF basin to the 200 Area ETF for processing or for basin-to-basin transfers. This pump is connected to a fixed manifold on one of four available risers.

Each basin consists of a multilayer liner system supported by a concrete anchor wall around the basin perimeter and a soil-bentonite clay underlayment. The multilayer liner system consists of a primary liner in contact with the aqueous waste, a layer of bentonite carpet, a geonet, a geotextile, a gravel layer, and a secondary liner that rests on the bentonite underlayment. Any aqueous waste leakage through the primary liner flows through the geonet and gravel to a leachate collection system. The leachate flows to a sump at the northwest corner of each basin, where the leachate is pumped up the side slope and back into the basin above the primary liner. Each liner is constructed of high-density polyethylene. A floating cover made of very low-density polyethylene is stretched over each basin above the primary liner. These covers serve to keep unwanted material from entering the basins, and to minimize evaporation of the liquid contents.

C.2 200 Area Effluent Treatment Facility Process Description

The 200 Area ETF is designed as a flexible treatment system that provides treatment for contaminants anticipated in process condensate and other onsite aqueous waste. The design influent flow rate into the 200 Area ETF is approximately 150 gallons per minute, with planned outages for activities such as maintenance on the 200 Area ETF systems. Maintenance outages typically are scheduled between treating a batch of aqueous waste, referred to as treatment campaigns. The effluent flow (or volume) is equivalent to the influent flow (or volume).

The 200 Area ETF generally receives aqueous waste directly from the LERF. However, aqueous waste also can be transferred from tanker trucks at the Load-In Station (2025-ED) and from containers (e.g., carboys, drums) directly to building 2025-E. Aqueous waste is treated and stored in 2025-E Process Areas in a series of tank systems, and process units. Within building 2025-E, waste also is managed in containers through treatment and/or storage. Figures C.2 and C.3 provide the relative locations of the process and container storage areas within the 200 Area ETF.

The process units are grouped in either the primary or the secondary treatment train. The primary treatment train provides for the removal or destruction of contaminants. Typically, the secondary treatment train processes the waste by-products from the primary treatment train by reducing the volume of waste. In the secondary treatment train, contaminants are concentrated and dried to a powder. The liquid fraction is routed to the primary treatment train. Figure C.2 provides an overview of the layout of the 2025-E building and the Load-In Station). Figure C.3 presents the Building 2025-E Ground Floor Plan, which includes the relative locations of the individual process units, and associated tanks.

The dry powder waste and maintenance and operations waste are containerized and stored or treated in the container storage areas, or accumulated in containers. Container secondary containment requirements are discussed in Section C.3.9 and removal of liquids is discussed in Section C.3.9.3. Secondary containment requirements for all tank systems is discussed in Section C.4.3.1.

In the following sections, several figures are provided that present general illustrations of the treatment units and the relation to the process.

C.2.1 2025-ED Load-In Station

The 200 Area ETF receives aqueous waste from LERF or the Load-In Station (2025-ED). The Load-In Station, located due east of the surge tank (Figure C.2), was designed and constructed to provide the capability to unload, store, and transfer aqueous waste to the LERF or 200 Area ETF from tanker trucks and other containers (such as drums). The Load-In Station consists of two truck bays equipped with Load-In Station tanks, transfer pumps, filtration system, level instrumentation for tanker trucks, leak detection capabilities for the containment basin and transfer line, and an underground transfer line that connects to lines in the surge tank berm, allowing transfers to either the surge tank or LERF. The Load-In Station is covered with a steel building for weather protection. Tanker trucks and other containers are used to unload aqueous waste at the Load-In Station. To perform unloading, the tanker truck is positioned on a truck pad, a 'load-in' transfer line is connected to the truck, and the tanker contents are pumped into the surge tank, or directly to the LERF. For container and small tanker truck unloading, the container is placed on the pad and the container contents are pumped into Load-In Station Tank 59A-TK-1, the surge tank, or directly to the LERF.

During unloading operations, solids may be removed from the waste by pumping the contents of the tanker truck or container through a filtration system. If solids removal is not needed, the filtration system is not used and the solution is transferred directly to the Load-In Station tanks, surge tank, or to LERF.

Any leaks at the Load-In Station drain to the sump. A leak detector in the sump alarms locally and in the 200 Area ETF Control Room. Alarms are monitored continuously in the 200 Area ETF Control Room during Load-In Station transfers and at least daily at times when waste is not being received at the Load-In Station. Alternatively, leaks can be visually detected.

C.2.2 200 Area Effluent Treatment Facility Operating Configuration

Because the operating configuration of the 200 Area ETF can be adjusted or modified, most aqueous waste streams can be effectively treated to below permitting limits. The operating configuration of the 200 Area ETF depends on the unique chemistry of an aqueous waste stream(s). Before an aqueous waste stream is accepted for treatment, the waste is characterized and evaluated. Information from the characterization is used to adjust the treatment process or change the configuration of the 200 Area ETF process units, as necessary, to optimize the treatment process for a particular aqueous waste stream.

Typically, an aqueous waste is processed first in the primary treatment train, where the 200 Area ETF is configured to process an aqueous waste through the Ultraviolet Light/Oxidation (UV/OX) unit first, followed by the Reverse Osmosis (RO) unit. However, under an alternate configuration, an aqueous waste could be processed in the RO unit first. For example, high concentrations of nitrates in an aqueous waste might interfere with the performance of the UV/OX. In this case, the 200 Area ETF could be configured to process the waste in the RO unit before the UV/OX unit.

The flexibility of the 200 Area ETF also allows some aqueous waste to be processed in the secondary treatment train first. For example, for small volume aqueous waste with high concentrations of some anions and metals, the approach could be to first process the waste stream in the secondary treatment train. This approach would prevent premature fouling or scaling of the RO unit. The liquid portion (i.e., untreated overheads from the Evaporator Vapor Body Vessel (60IEV-1) and thin film dryer) would be sent to the primary treatment train.

Figures C.4 and C.5 provide example process flow diagrams for two different operating configurations.

C.2.3 Primary Treatment Train

The primary treatment train consists of the following processes:

- Influent Receipt/Surge tank - inlet, surge capacity.
- Filtration - for suspended solids removal.
- UV/OX - organic destruction.
- pH adjustment - waste neutralization.
- Hydrogen peroxide decomposition - removal of excess hydrogen peroxide.
- Degasification - removal of carbon dioxide.
- RO - removal of dissolved solids.
- IX - removal of dissolved solids.
- Verification - holding tanks during verification.

Influent Receipt/Surge Tank. Depending on the configuration of the 200 Area ETF, the surge tank is one inlet used to feed an aqueous waste into the 200 Area ETF for treatment. In Configuration 1 (Figure C.4), the surge tank is the first component downstream of the LERF. The surge tank provides a storage/surge volume for chemical pretreatment and controls feed flow rates from the LERF to the 200 Area ETF. However, in Configuration 2 (Figure C.5), aqueous waste from LERF is fed directly into the treatment units. In this configuration, the surge tank receives aqueous waste, which has been processed in the RO units, and provides the feed stream to the remaining downstream process units. In yet another configuration, some small volume aqueous waste could be received into the secondary treatment train first for processing. In this case, the aqueous waste would be received directly into the secondary waste receiving tanks. Finally, the surge tank also receives waste extracted from various systems within the primary and secondary treatment train while in operation.

The surge tank is located outside building 2025-E on the south side. In the surge tank (Figure C.6), the pH of an aqueous waste is adjusted using the metered addition of sulfuric acid and sodium hydroxide, as necessary, to prepare the waste for treatment in downstream processes. In addition, hydrogen peroxide or biocides could be added to control biological growth in the surge tank. A pump recirculates the contents in the surge tank, mixing the chemical reagents with the waste to a uniform pH.

Filtration. Two primary filter systems remove suspended particles in an aqueous waste: a rough filter removes the larger particulates, while a fine filter removes the smaller particulates. The location of these filters depends on the configuration of the primary treatment train. However, the filters normally are located upstream of the RO units.

The solids accumulating on these filter elements are backwashed to the secondary waste receiving tanks with pulses of compressed air and water, forcing water back through the filter. The backwash operation is initiated either automatically by a rise in differential pressure across the filter or manually by an operator. The filters are cleaned chemically when the backwashing process does not facilitate acceptable filter performance.

Auxiliary fine and rough filters (e.g., disposable filters) have been installed to provide additional filtration capabilities. Depending on the configuration of the 200 Area ETF, the auxiliary filters are operated either in series with the primary filters to provide additional filtration or in parallel, instead of the primary fine and rough filters, to allow cleaning/maintenance of the primary fine and rough filters while the primary treatment train is in operation.

Ultraviolet Light/Oxidation (UV/OX). Organic compounds contained in an aqueous waste stream are destroyed in the UV/OX system (Figure C.7). Hydrogen peroxide is mixed with the waste. The UV/OX system uses the photochemical reaction of UV light on hydrogen peroxide to form hydroxyl radicals and other reactive species that oxidize the organic compounds. The final products of the complete reaction are carbon dioxide, water, and inorganic ions.

Organic destruction is accomplished in two UV/OX units operating in parallel. During the UV/OX process, the aqueous waste passes through reaction chambers where hydrogen peroxide is added. While in the UV/OX system, the temperature of an aqueous waste is monitored. Heat exchangers are used to reduce the temperature of the waste should the temperature of the waste approach the upper limits for the UV/OX or RO systems.

pH Adjustment. The pH of a waste stream is monitored and controlled at different points throughout the treatment process. Within the primary treatment train, the pH of a waste can be adjusted with sulfuric acid or sodium hydroxide to optimize operation of downstream treatment processes or adjusted before final discharge. For example, the pH of an aqueous waste would be adjusted in the pH adjustment tank after the UV/OX process and before the RO process. In this example, pH is adjusted to cause certain chemical species such as ammonia to form ammonium sulfate, thereby increasing the rejection rate of the RO.

Hydrogen Peroxide Decomposition. Typically, hydrogen peroxide added into the UV/OX system is not consumed completely by the system. Because hydrogen peroxide is a strong oxidizer, the residual hydrogen peroxide from the UV/OX system is removed to protect the downstream equipment. The hydrogen peroxide decomposer uses a catalyst to break down the hydrogen peroxide that is not consumed completely in the process of organic destruction. The aqueous waste is sent through a column that breaks down the hydrogen peroxide into water and oxygen. The gas generated by the decomposition of the hydrogen peroxide is vented to the vessel off gas system.

Degasification. The degasification column is used to purge dissolved carbon dioxide from the aqueous waste to reduce the carbonate loading to downstream dissolved solids removal processes within the 200 Area ETF primary treatment train. The purged carbon dioxide is vented to the vessel off gas system.

Reverse Osmosis (RO). The RO system (Figure C.8) uses pressure to force clean water molecules through semi-permeable membranes while keeping the larger molecule contaminants, such as dissolved solids, and large molecular weight organic materials, in the membrane. The RO process uses a staged configuration to maximize water recovery. The process produces two separate streams, including a clean 'permeate' and a concentrate (or retentate), which are concentrated as much as possible to minimize the amount of secondary waste produced.

The RO process is divided into first and second stages. Aqueous waste is fed to the first RO stage from the RO feed tank. The secondary waste receiving tanks of the secondary treatment train receive the retentate removed from the first RO stage, while the second RO stage receives the permeate (i.e., 'treated' aqueous waste from the first RO stage). In the second RO stage, the retentate is sent to the first stage RO feed tank while the permeate is sent to the IX system or to the surge tank, depending on the configuration of the 200 Area ETF.

Two support systems facilitate this process. An anti-scale system injects scale inhibitors as needed into the feed waste to prevent scale from forming on the membrane surface. A clean-in-place system using cleaning agents, such as descalants and surfactants, cleans the membrane pores of surface and subsurface deposits that have fouled the membranes.

Ion Exchange. Because the RO process removes most of the dissolved solids in an aqueous waste, the IX process (Figure C.9) acts as a polishing unit. The IX system consists of three columns containing beds of cation and/or anion resins. This system is designed to allow for regeneration of resins and maintenance of one column while the other two are in operation. Though the two columns generally are operated in series, the two columns also can be operated in parallel or individually.

Typically, the two columns in operation are arranged in a primary/secondary (lead/lag) configuration, and the third (regenerated) column is maintained in standby.

When dissolved solids breakthrough the first IX column and are detected by a conductivity sensor, this column is removed from service for regeneration, and the second column replaces the first column and the third column is placed into service. The column normally is regenerated using sulfuric acid and sodium hydroxide. The resulting regeneration waste is collected in the secondary waste receiving tanks.

Spent resins are transferred into a disposal container should regeneration of the IX resins become inefficient Free water is removed from the container and returned to the surge tank. Dewatered resins are transferred to a final storage/disposal point.

Verification. The three verification tanks (Figure C.10) are used to hold the treated effluent while a determination is made that the effluent meets discharge limits. The effluent can be returned to the primary treatment train for additional treatment, or to the LERF, should a treated effluent not meet Waste Discharge Permit ST0004500 requirements.

The three verification tanks alternate between three operating modes: receiving treated effluent, holding treated effluent during laboratory analysis and verification, or discharging verified effluent. Treated effluent may also be returned to the 200 Area ETF to provide 'clean' service water for operational and maintenance functions, e.g., for boiler water and for backwashing the filters. This recycling keeps the quantity of fresh water used to a minimum.

C.2.4 Secondary Treatment Train

The secondary treatment system typically receives and processes the following by-products generated from the primary treatment train: concentrate from the first RO stage, filter backwash, regeneration waste from the ion exchange system, and spillage or overflow received into the process sumps. Depending on the operating configuration, however, some aqueous waste could be processed in the secondary treatment train before the primary treatment train (refer to Figures C.4 and C.5 for example operating configurations).

The secondary treatment train provides the following processes:

- Secondary waste receiving - tank receiving and chemical addition.
- Evaporation - concentrates secondary waste streams.
- Concentrate staging - concentrate receipt, pH adjustment, and chemical addition.
- Thin film drying - dewatering of secondary waste streams.
- Container handling - packaging of dewatered secondary waste.

Secondary Waste Receiving. Waste to be processed in the secondary treatment train is received into two secondary waste receiving tanks, where the pH can be adjusted with sulfuric acid or sodium hydroxide for optimum evaporator performance. Chemicals, such as reducing agents, may be added to waste in the secondary waste receiving tanks to reduce the toxicity or mobility of constituents in the powder.

Evaporation. The Evaporator Vapor Body Vessel (60IEV-1) is fed alternately by the two secondary waste receiving tanks. One tank serves as a waste receiver while the other tank is operated as the feed tank. The Evaporator Vapor Body Vessel (also referred to as the vapor body) is the principal component of the evaporation process (Figure C.11).

Feed from the secondary waste receiving tanks is pumped through a heater to the recirculation loop of the 200 Area ETF Evaporator. In this loop, concentrated waste is recirculated from the Evaporator Vapor Body Vessel, to a heater, and back into the evaporator where vaporization occurs. As water leaves the evaporator system in the vapor phase, the concentration of the waste in the evaporator increases. When the concentration of the waste reaches the appropriate density, a portion of the concentrate is pumped to one of the concentrate tanks.

The vapor that is released from the Evaporator Vapor Body Vessel is routed to the entrainment separator, where water droplets and/or particulates are separated from the vapor. The 'cleaned' vapor is routed to the vapor compressor and converted to steam.

The steam from the vapor compressor is sent to the heater (reboiler) and used to heat the recirculating concentrate in the Evaporator Vapor Body Vessel. From the heater, the steam is condensed and fed to the distillate flash tank, where the saturated condensate received from the heater drops to atmospheric pressure and cools to the normal boiling point through partial flashing (rapid vaporization caused by a pressure reduction). The resulting distillate is routed to the surge tank. The non-condensable vapors, such as air, are vented through a vent gas cooler to the vessel off gas system.

Concentrate Staging. The concentrate tanks make up the head end of the thin film drying process. From the Evaporator Vapor Body Vessel, concentrate is pumped into two concentrate tanks, and pH adjusted chemicals, such as reducing agents, may be added to reduce the toxicity or mobility of constituents when converted to powder. Waste is transferred from the concentrate tanks to the thin film dryer for conversion to a powder. The concentrate tanks function alternately between concentrate receiver and feed tank for the thin film dryer. However, one tank may serve as both concentrate receiver and feed tank.

Because low solubility solids (i.e., calcium and magnesium sulfate) tend to settle in the concentrate tanks, these solids must be removed to prevent fouling and to protect the thin film dryer, and to maintain concentrate tank capacity.

Thin Film Drying. From the concentrate tanks, feed is pumped to the thin film dryer (Figure C.12) that is heated by steam. As the concentrated waste flows down the length of the dryer, the waste is dried. The dried film, or powder, is scraped off the dryer cylinder by blades attached to a rotating shaft. The powder is funneled through a cone-shaped powder hopper at the bottom of the dryer and into the Container Handling System.

Overhead vapor released by the drying of the concentrate is condensed in the distillate condenser. Excess heat is removed from the distillate by a water-cooled heat exchanger. Part of the distillate is circulated back to the condenser spray nozzles. The remaining distillate is pumped to the surge tank. Any noncondensable vapors and particulates from the spray condenser are exhausted to the vessel off gas system.

Container Handling. Before an empty container is moved into the Container Handling System (Figure C.13), located in the container handling room (Figure C.2) the lid is removed and the container is placed on a conveyor. The containers are moved into the container filling area after passing through an air lock. The empty container is located under the thin film dryer, and raised into position. The container is sealed to the thin film dryer and a rotary valve begins the transfer of powder to the empty container. Air displaced from the container is vented to the distillate condenser attached to the Evaporator Vapor Body Vessel that exhausts to the vessel off gas system.

The container is filled to a predetermined level, then lowered from the thin film dryer and moved along a conveyor. The filled container is manually recapped, and moved along the conveyor to the airlock. At the airlock, the container is moved onto the conveyor by remote control. The airlock is opened, the smear sample (surface wipe) is taken, and the contamination level counted. A 'C' ring is installed to secure the container lid. If the container has contaminated material on the outside, the container is wiped down and retested. Filled containers that pass the smear test are labeled, placed on pallets, and can be moved by forklift to any of the 5-Container Storage and Treatment areas; normally they are moved to the 2025-E Container Storage Area. Section C.3 provides a more detailed discussion of container handling.

C.2.5 Other 200 Area Effluent Treatment Facility Systems

The 200 Area ETF is provided with support systems that facilitate treatment in the primary and secondary treatment trains and that provide for worker safety and environmental protection. An overview of the following systems is provided:

- Monitor and control system
- Vessel off gas system
- Sump collection system
- Chemical injection feed system

- Verification tank recycle system
- Laboratory Area
- Utilities

C.2.5.1 Monitor and Control System

The operation of the 200 Area ETF is monitored and controlled by a centralized computer system (i.e., monitor and control system or MCS). The MCS continuously monitors data from various field indicators, such as pH, flow, tank level, temperature, pressure, conductivity, alarm status, and valve switch positions. Data gathered by the MCS enable operations and engineering personnel to document and adjust the operation of the 200 Area ETF.

Emergency communications equipment and warning systems (e.g. fire alarms and evacuation alarms) are included in Addendum J, Contingency Plan. These emergency response notification alarms are monitored continuously at central Hanford Facility locations (e.g. Hanford Fire Station) and do not rely on staff being present in the 200 Area ETF Control Room for notification and response.

C.2.5.2 Vessel Off Gas System

Ventilation for various tanks and vessels is provided through the vessel off gas system. The system includes a moisture separator, duct heater, pre-filter, high-efficiency particulate air filters, carbon absorber (when required to reduce organic emissions), exhaust fans, and ductwork. Gasses ventilated from the tanks and vessels enter the exhaust system through the connected ductwork. The vessel off gas system draws vapors and gasses off the following tanks and treatment systems:

- Surge tank (60A-TK-1)
- Vent gas cooler (off the Evaporator Vapor Body Vessel (60I-EV-1)/distillate flash tank) (60I-TK-2)
- pH adjustment tank (60C-TK-1)
- Concentrate tanks (2025E-60J-TK-1A/ 2025E-60J-TK-1B)
- Degasification system
- First and second RO stages
- Dry powder hopper
- Effluent pH adjustment tank (60C-TK-2)
- Drum capping station
- Secondary waste receiving tanks (60I-TK-1A /60I-TK-1B)
- Distillate condenser (off the thin film dryer)
- Sump tanks 1 and 2

The vessel off gas system maintains a negative pressure with respect to the atmosphere, which produces a slight vacuum within tanks, vessels, and ancillary equipment for the containment of gas vapor. This system also provides for the collection, monitoring, and treatment of confined airborne in-vessel contaminants to preclude over-pressurization. The high-efficiency particulate air filters remove particulates and condensate from the air stream before these are discharged to the heating, ventilation, and air conditioning system.

C.2.5.3 Sump Collection System

Sump Tanks 1 and 2 compose the sump collection system that provides containment of waste streams and liquid overflow associated with the 200 Area ETF processes. The 2025-E Process Area floor is sloped to two separate trenches that each drain to a sump tank located under the floor of building 2025-E (Figure C.14). One trench runs the length of the primary treatment train and drains to Sump Tank 2, located underneath the verification tank pump floor. The second trench collects spillage primarily from the secondary treatment train and flows to Sump Tank 1, located near the Evaporator Vapor Body Vessel. Sump Tanks 1 and 2 are located below floor level (Figure C.14). An eductor in these tanks prevents sludge from accumulating.

C.2.5.4 Chemical Injection Feed System

At several points within the primary and secondary treatment trains, sulfuric acid and sodium hydroxide (or dilute solutions of these reagents) are metered into specific process units to adjust the pH. For example, a dilute solution of 4 percent sulfuric acid and 4 percent sodium hydroxide could be added to the secondary waste receiving tanks to optimize the evaporation process.

C.2.5.5 Verification Tank Recycle System

To reduce the amount of water added to the process, verification tank water (i.e., verified effluent) is recycled throughout the 200 Area ETF process. Tanks and ancillary equipment that use verification tank water include:

- 4 percent H_2SO4 solution tank and ancillary equipment.
- 4 percent NaOH solution tank and ancillary equipment.
- Clean-in-place tank and ancillary equipment.
- IX columns (during resin regeneration).
- Evaporator Vapor Body Vessel boiler and ancillary equipment.
- Thin film dryer boiler and ancillary equipment.
- Seal water system.

In addition, verification tank water is used extensively during maintenance activities. For example, it may be used to flush piping systems or to confirm the integrity of piping, a process tank, or tank truck.

C.2.5.6 Laboratory Area

The Laboratory Area is located adjacent to the 2025-E Process Area. The Laboratory Area includes two sinks that drain to Sump Tank 2. The sinks are used to clean and rinse equipment that has come in contact with process waste.

C.2.5.7 Utilities

The 200 Area ETF maintains the following utility supply systems required for the operation:

- Cooling water system - removes heat from process water via heat exchangers and a cooling tower.
- Compressed air system - provides air to process equipment and instrumentation.
- Seal water system - provides cool, clean, pressurized water to process equipment for pump seal cooling and pump seal lubrication, and provides protection against failure and fluid leakage.
- Demineralized water system - removes solids from raw water system to produce high quality, low ion-content, water for steam boilers, and for the hydrogen peroxide feed system.
- Heating, ventilation, and air conditioning system - provides continuous heating, cooling, and air humidity control throughout building 2025-E.

The following utilities support 200 Area ETF activities:

- Electrical power
- Sanitary water
- Communication systems
- Raw water

C.3 Containers

This section provides specific information on container storage and treatment operations at the 200 Area ETF, including descriptions of containers, labeling, and secondary containment structures. See Figures C.2 and C.3 for layout of Building 2025-E.

Per Addendum A, Part A Form the maximum volume of dangerous and/or mixed waste that can be stored in containers is 39,000 gallons. A list of dangerous and/or mixed waste managed in containers at the 200 Area ETF is also provided in Addendum A, Part A Form. The types of dangerous and/or mixed waste managed in containers in the 200 Area ETF could include:

- Secondary waste powder generated from the treatment process.
- Aqueous waste received from other Hanford site sources awaiting treatment.
- Miscellaneous waste generated by operations and maintenance activities. The waste could include process waste, such as used filter elements; spent RO membranes; damaged equipment, and decontamination and maintenance waste, such as contaminated rags, gloves, and other personal protective equipment. Containers of miscellaneous solid waste (e.g., debris) that may contain free liquids are packaged with absorbents.

The secondary treatment train processes the waste by-products from the primary treatment train, which are concentrated and dried into a powder. Containers are filled with dry powder waste from the thin film dryer via a remotely controlled system. Containers of aqueous waste received from other Hanford site sources are stored at 200 Area ETF until their contents can be transferred to the process for treatment. The waste is usually transferred to the secondary waste receiving or concentration tanks. Containers at the 2025-ED Load-In Station are transferred into Load-In Station tank 59A-TK-1, or directly to the surge tank, or to a LERF basin via a pipeline.

As indicated in Table C.1 and Addendum A, Part A Form, waste is also placed in containers for treatment. The types of treatment performed in containers at the 200 Area ETF includes, but is not limited to the following:

- Adding absorbent material to waste in a container or adding waste to absorbent material in a container to soak up free liquids. For example, containers of miscellaneous solid waste (i.e., debris) that may contain free liquids are packaged with absorbents.
- Decanting free liquids from the containers to 200 Area ETF tanks or other containers before absorbents are added.
- Repackaging previously containerized waste into new containers.

Following treatment, the containerized waste either is stored at the 200 Area ETF or transferred to another treatment, storage, and disposal (TSD) operating unit.

C.3.1 2025-E Process Area

The waste primarily consists of containers that function as part of the waste management process. Waste streams are accumulated into DOT approved containers near a specific operation within the 2025-E Process Area. The containers primarily store miscellaneous waste generated from maintenance and operations activities. Treatment activities include decanting and the use of absorbents for liquid stabilization. Another function of the waste management process is to store aqueous waste containers from other Hanford Site sources in the 2025-E Process Area and transfer the waste into the 200 Area ETF tanks for processing. Once the 2025-E Process Area containers are full, the containers are moved to the 2025-E Container Storage Area, the Outside Container Storage Area, another TSD facility, or the Environmental Restoration Disposal Facility (ERDF).

C.3.2 2025-E Truck Bay

The 2025-E Truck Bay is primarily used to store containers between the 2025-E Process Area, 2025-E Container Storage Area, and Outside Container Storage Area. Dry powder and containers of miscellaneous waste are removed from the Container Handling System to the 2025-E Truck Bay; weighed and placed on pallets before transfer to the 2025-E Container Storage Area or the Outside Container Storage Area. Additionally, the 2025-E Truck Bay supports truck unloading of aqueous waste containers from other Hanford Site sources, and loading of powder and miscellaneous waste containers.

The Truck Bay can also be used for container storage and treatment. The waste streams stored in the containers are primarily dry powder, aqueous waste awaiting treatment, and miscellaneous waste generated from maintenance and operations activities. Container treatment is described in Section C.3. However, container storage and treatment are not typically performed because of the limited space available in the 2025-E Truck Bay. The 2025-E Truck Bay is a 53.3 x 27.9-foot room with large openings to the 2025-E Process Area to the west, outside Container Storage Area to the east, and 2025-E Container Storage Area to the south. The first two openings include roll up doors for ventilation control.

C.3.3 2025-E Container Storage Area

The 2025-E Container Storage Area is primarily used to store containers of dry powder, aqueous waste awaiting treatment, and to treat and store miscellaneous waste generated from maintenance and operations activities as described in Section C.3. The 2025-E Container Storage Area is a 75 x 27.9-foot room located adjacent to the 2025-E Process Area.

C.3.4 Outside Container Storage Area

The Outside Container Storage Area is primarily used to store containers of dry powder and miscellaneous waste from maintenance and operations activities that are treated with absorbents to remove free liquids (refer to Section C.3 for container treatment). The Outside Container Storage Area does not have secondary containment; therefore, in the rare case where storage or treatment of containers with free liquids is needed, portable secondary containment would be installed as described in Section C.3.9.

Containers are transferred from LERF and other 200 Area ETF locations to the Outside Container Storage Area in preparation for transport to another TSD facility. Containers may be transferred by forklift, approved transport vehicle, or by hand. The Outside Container Storage Area is located northeast of the 2025-E Building, and includes an area east of the Verification Tank berm. The asphalt is labeled to identify the western and southern boundaries of the Outside Container Storage Area.

C.3.5 2025-ED Load-In Station

The 2025-ED Load-In Station is primarily used to store aqueous waste in tanker trucks and other containers (such as drums, or totes) from other Hanford Site sources until the waste is transferred into one of the Load-In Station tanks, surge tank, or directly to LERF. The waste streams received and stored at the 2025-ED Load-In Station have been evaluated and determined to meet the waste acceptance criteria. Containers at the 2025-ED Load-In Station are managed in two truck bays located in a steel building for weather protection.

Miscellaneous waste is also stored and treated at the Load-In Station. Containers of miscellaneous solid waste (i.e. debris) that may contain free liquids are packaged with absorbents. Refer to Section C.3 for types of treatment performed in containers.

C.3.6 Description of Containers

The containers used to collect and store dry powder waste are 55-gallon steel containers. Most of the aqueous waste received at 200 Area ETF are stored in 55-gallon steel or plastic containers; however, in a few cases, the size of the container could vary to accommodate the size of a particular waste. For example, aqueous waste may be received in totes containing approximately 350 gallons. Tanker trucks used to receive aqueous waste at the 2025-E Load-In Station may be steel or plastic, with sizes varying from 200 to 10,000 gallons.

Maintenance and operation waste generated at 200 Area ETF may be placed in a wide variety of containers, depending on size and quantity of the waste involved. In addition to 55-gallon containers, hard or soft-sided containers of various sizes may be used; the typical size of a soft-sided container is 4 x 4 x 4 feet. When large amounts of waste are generated, such as a major equipment replacement, larger containers, such as 23 x 8 x 5-foot roll-off boxes, may be used. In the case of spent resin from the IX columns, the resin is dewatered, and could be packaged in a special disposal container. In these few cases, specially sized containers could be required. In all cases, however, only approved containers are used and are compatible with the associated waste. Typically, 55-gallon containers are used for treatment.

Current operating practices indicate the use of new 55-gallon containers that have either a polyethylene liner or a protective coating. Any reused or reconditioned container is inspected for container integrity before use. Overpack containers are available for use with damaged containers. Overpack containers typically are unlined steel or polyethylene.

C.3.7 Container Management Practices

Storage containers can be moved between the DWMUs identified in Table C.1 to support LERF and 200 Area ETF waste management processes. Before use, each container is checked for signs of damage such as dents, distortion, corrosion, or scratched coating. For dry powder loading, empty containers on pallets are raised by a forklift and manually placed on the conveyor that transports the containers to the automatic filling station in the container handling room (Figure C.2). The container lids are removed and replaced manually following the filling sequence. After filling, containers exit the container handling room via the filled drum conveyor, the locking rings are installed, and the container label is affixed. The containers are moved by dolly or forklift to the 2025-E Truck Bay, 2025-E Container Storage Area, or Outside Container Storage Area.

Before receipt at 200 Area ETF, each container from other Hanford site sources is inspected for leaks, signs of damage, and a loose lid. The identification number on each container is checked to ensure the proper container is received. The containers are typically placed on pallets in the 2025-E Truck Bay and moved by dolly or forklift to the 2025-E Container Storage Area. These containers are later moved to the 2025-E Process Area and the contents transferred to the process for treatment.

2025-E Process Area containers used for storing and treating maintenance and operations secondary waste are labeled before being placed in the container storage areas. Lids are secured on these containers when not being filled. When the containers in the 2025-E Process Area are full, the containers are transferred by dolly or forklift to the 2025-E Container Storage Area, Outside Container Storage Area, or to an appropriate TSD facility. Containers used for treating waste also are labeled. The lids on these containers are removed as required to allow for treatment. During treatment, access to these containers is controlled through physical barriers and/or administrative controls.

The filled containers in the container storage areas are inventoried, checked for proper labeling, and placed on pallets or in a separate containment device as necessary (refer to Section C.3.9.4, Prevention of Ignitable, Reactive, and Incompatible Wastes in Containers). Each pallet is moved by forklift. Within the container storage areas, palletized containers are stacked no more than three pallets high and in rows no more than two containers wide. Aisles are unobstructed with a minimum of 30-inch aisle space between rows.

C.3.8 Container Labeling

Labels are affixed on containers used to store dry powder when the containers leave the container handling room. Labels are affixed on other waste containers before use. Every container is labeled with the date that the container was filled. Appropriate major risk labels, such as "corrosive", "toxic", or

"F-listed", also are added. Each container also has a label with an identification number for tracking purposes.

C.3.9 Secondary Container Containment Requirements/Design

Secondary containment is provided in the container storage and/or treatment areas in building 2025-E (2025-E Process Area, 2025-E Truck Bay, and 2025-E Container Storage Area). The 2025-E secondary containment for the container storage and/or treatment areas is also shared with the tank systems, and ancillary equipment of the primary and secondary treatment trains. Secondary containment systems, such as spill pallets, will be used for incompatible waste to ensure separation of the incompatible waste. The 2025-E building roof and walls protect all containers from exposure to the elements.

The 2025-E building floor, trenches, and a 6-inch rise (berm) along the walls of the 2025-E Process Area and 2025-E Container Storage Area provides secondary containment for the 2025-E container storage and/or treatment areas. The floor is a jointed cast-in-place, pre-formed reinforced concrete slab floor. This floor is a minimum of 6 inches thick. All slab joints and floor and wall joints have water stops installed at the mid-depth of the slab. In addition, filler was applied to each joint. The floor and berms are coated with a chemically resistant high-solids epoxy coating system. This coating material is compatible with the waste managed in containers and is an integral part of the secondary containment system for containers. The doorsills are 6-inches high to contain liquid leaks and spills.

The floor is sloped to drain any solution in the 2025-E Truck Bay and 2025-E Container Storage Area to floor drains along the west wall. Each floor drain consists of a grating over an 8-inch diameter drain port connected to a 4-inch polyvinyl chloride transfer pipe. The pipe passes under this wall and connects to a trench running along the east wall of the adjacent 2025-E Process Area. This trench drains solution to Sump Tank 1.

The 2025-E Truck Bay and 2025-E Container Storage Area are separated from the 2025-E Process Area by a common wall and a door for access to the two areas (Figure C.2). These two areas also share a common floor and trenches that, with the 6-inch rise of the containing walls, form the secondary containment system for the 2025-E Process Area and the 2025-E Container Storage Area.

The 2025-E Process Area, 2025-E Truck Bay, and 2025-E Container Storage Area have interconnected floor drains. The combined volume available for secondary containment is 24,600 gallons. This volume is greater than 10 percent of the maximum total volume of containers allowed for storage in the building 2025-E (reference CHPRC-01900). All systems were designed to national codes and standards (e.g., American Society for Testing Materials, American Concrete Institute standards).

- 2025-E Process Area secondary containment volume is approximately 17,800 gallons
- 2025-E Container Storage Area secondary containment volume is approximately is 4,000 gallons
- 2025-E Truck Bay secondary containment volume is approximately is 2,800 gallons.

The Outside Container Storage Area does not have a constructed secondary containment system. In the rare cases where storage or treatment of containers with free liquids is needed, waste containers, requiring secondary containment for liquid will be stored over portable secondary containment. When waste is stored on portable secondary containment, the drain plug (if existing) is kept closed. The secondary containment systems will be designed to be elevated to protect from accumulated liquids, contain over 10 percent of the volume of all containers or 100 percent of the largest container, whichever is greater; and the additional volume that would result from precipitation of a maximum 25-year storm of 24 hours duration in accordance with WAC 173-303-630(7)(c).

The 2025-ED Load-In Station has 10-inch-thick reinforced concrete truck pads in the east and west bays that provide secondary containment for the 2025-ED Load-In Station container storage areas. The truck pad in the east bay has a shallow 8 x 13-foot floor depression designed to drain away any liquids. The floor depression is sloped to allow the liquid to drain through an opening in the curb between the truck bays to the Tank 59-TK-1 catch basin and then to the west bay truck pad. The truck pad in the west bay is a 40 x 18.7-foot pad with a 6-inch curb to contain liquid spills. The central section of the west bay truck pad extends about 6 feet outside the building to the adjacent Load-In Station tank containment pit. The west truck pad is coated and the east truck pad floor depression is coated. Both truck pads are inside the metal Load-In Station building and are sloped to drain to the Load-In Station tank secondary containment pit through a drainpipe located in the east wall of the containment basin. The Load-In Station containment pit is described in Section C.4.3.1.2. The volume of the pit is 19,300 gallons, which is greater than the volume of the largest tanker expected to be received. A leak detector in the 2025-ED Load-In Station containment pit sump alarms locally and in the 200 Area ETF Control Room. Alarms are monitored continuously in the 200 Area ETF Control Room during Load-In Station transfers and at least daily at times when waste is not being received at the 2025-E Load-In Station. Alternatively, leaks can be visually detected.

C.3.9.1 Structural Integrity of Base

Engineering calculations were performed showing the floor of the 2025-E Container Storage Area is capable of supporting the weight of containers. These calculations were reviewed and certified by a professional engineer (*Final RCRA Information Needs Report,* Mausshardt 1995). The concrete was inspected for damage during construction. Cracks were identified and repaired to the satisfaction of the professional engineer. Documentation of these certifications is included in the engineering assessment (*Final RCRA Information Needs Report,* Mausshardt 1995).

C.3.9.2 Control of Run-on

Building 2025-E serves to prevent run-on of precipitation for the container management areas that are located within building 2025-E. Building 2025-ED serves to prevent run-on of precipitation for the 2025-ED Load-In Station container storage area.

The Outside Container Storage Area run-on will be controlled by drainage sloping away from the storage area. Waste containers stored without secondary containment in the Outside Container Storage Area will be elevated to prevent contact with any run-on or accumulated liquids.

C.3.9.3 Removal of Liquids from Containment Systems

The 2025-E Container Storage Area is equipped with drains that route solution to a trench in the 2025-E Process Area, which drains to Sump Tank 1. The sump tanks are equipped with alarms that notify operating personnel that a leak is occurring. The sump tanks also are equipped with pumps to transfer waste to the surge tank or the secondary treatment train. Additional information on removal of liquids is provided in Section C.2, and Section C.4.3.1.2.

Spilled or leaked material (i.e., waste) from Sump Tank 1 or Sump Tank 2 is fed to either the surge tank and processed in the primary treatment train or to the secondary waste receiving tanks and processed in the secondary treatment train.

2025-E Process Area. The floor of the 2025-E Process Area is sloped to drain liquids to two trenches that drain to Sump Tanks 1 and 2. The sump tanks are equipped with level monitoring and detection alarms that notify operating personnel that a leak is occurring. The sump tanks also are equipped with pumps to transfer waste to the surge tank or the secondary treatment train.

2025-E Truck Bay. Liquids from the 2025-E Truck Bay are routed to a trench that drains to Sump Tank 1. The sump tank is equipped with level monitoring and a detection alarm that notifies operating personnel that a leak is occurring. The sump tank also is equipped with a pump to transfer waste to the surge tank or the secondary treatment train.

2025-E Container Storage Area. The 2025-E Container Storage Area is equipped with drains that route solution to a trench in the 2025-E Process Area, which drains to Sump Tank 1. The sump tank is equipped with level monitoring and a detection alarm that notifies operating personnel that a leak is occurring. The sump tank also is equipped with a pump to transfer waste to the surge tank or the secondary treatment train.

Outside Container Storage Area. The Outside Container Storage Area does not have a secondary containment system. For control of run-on, refer to Section C.3.9.2.

2025-ED Load-In Station. The container unloading and storage areas in the Load-In Station are designed to drain to the Load-In Station tank secondary containment pit. The pit is equipped with a leak detector and a pump to transfer waste to the Load-In Station tanks, surge tank, or LERF.

C.3.9.4 Prevention of Ignitable, Reactive, and Incompatible Wastes in Containers

Containers of incompatible wastes may be managed in any of the permitted container storage areas and must meet the requirements listed in WAC 173-303-640(9) and as described in this section. Individual waste types (i.e., ignitable, corrosive, and reactive) are stored in separate containers. A waste that could be incompatible with other wastes is separated and protected from the incompatible waste. Incompatible wastes are evaluated using the methodology documented in 40 CFR 264, Appendix V. For example, acidic and caustic wastes are stored in separate containers. Free liquids are absorbed in miscellaneous waste containers that hold incompatible waste. Additionally, 200 Area ETF-specific packaging requirements for these types of waste provide extra containment with each individual container. For example, each item of acidic waste is individually bagged and sealed within a lined container.

C.4 Tank Systems

This section provides specific information on tank systems and process units. This section also includes a discussion on the types of waste to be managed in the tanks, tank design information, integrity assessments, and additional information on the 200 Area ETF tanks that treat and store dangerous and/or mixed waste. The 200 Area ETF dangerous waste tanks are identified in Section C.4.1.1. Table C.6, *200 Area ETF Tank Systems Information*, Table C.7, *200 Area ETF Additional Tank System Information*, and Table C.8, *Ancillary Equipment and Material Data* provides individual tank volumes, dimensions, and construction materials. The relative locations of the tanks and process units are presented in Figures C.2 and C.3.

C.4.1 Design Requirements

The following sections provide an overview of the design specifications for the tanks within the 200 Area ETF. A separate discussion on the design of the process units also is provided. In accordance with the new tank system requirements of WAC 173-303-640(3), the following tank components and specifications were assessed:

- Dimensions, capacities, wall thicknesses, and pipe connections.
- Materials of construction and linings and compatibility of materials with the waste being processed.
- Materials of construction of foundations and structural supports.
- Design codes and standards used in construction.
- Structural design calculations, including seismic design basis.
- Waste characteristics and the effects of waste on corrosion.

This assessment was documented in the *Final RCRA Information Needs Report* (*Final RCRA Information Needs Report*, Mausshardt 1995; the engineering assessment performed for the 200 Area ETF tank systems by an independent professional engineer. A similar assessment of design requirements was performed for Load-In Station tanks 59A-TK-109 and 59A-TK-117 and is documented in *200 Area Effluent BAT/AKART Implementation, ETF Truck Load-in Facility, Project W-291H Integrity Assessment Report* (W-291H-IAR, KEH 1995). An assessment was also performed when Load-In Station tank 59A-TK-1 was placed into service for receipt of dangerous and mixed wastes. The assessment is documented in the *200 Area Effluent Treatment Facility Purgewater Unloading Facility Tank System Integrity Assessment* (HNF-41604, 2009).

The specifications for the preparation, design, and construction of the tank systems at the 200 Area ETF are documented in the *Design Construction Specification, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (V-C018HC1-001, WHC 1992). The preparation, design, and construction of Load-In Station tanks 59A-TK-109 and 59A-TK-117 are provided in the construction specifications in *Project W-291, 200 Area Effluent BAT/AKART Implementation ETF Truck Load-in Facility, Construction Specifications* (*W-291H-C2*, KEH 1994). The preparation, design, and construction of Load-In Station tank 59A-TK-1 are documented in *Purgewater Unloading Facility Project Documentation* (HNF-39966, 2009).

Most of the tanks in the 200 Area ETF are constructed of stainless steel. According to the design of the 200 Area ETF, it was determined stainless steel would provide adequate corrosion protection for these tanks. Exceptions include Load-In Station tank 59A-TK-1, which is constructed of fiberglass-reinforced plastic and the verification tanks, which are constructed of carbon steel with an epoxy coating. The Evaporator Vapor Body Vessel (and the internal surfaces of the thin film dryer) is constructed of a corrosion resistant alloy, known as alloy 625, to address the specific corrosion concerns in the secondary treatment train. Finally, the hydrogen peroxide decomposer vessels are constructed of carbon steel and coated with a vinyl ester lining.

The shell thicknesses of the tanks identified in Table C.6 represent a nominal thickness of a new tank when placed into operation. The tank capacities identified in this table represent the maximum volumes. Nominal tank volumes discussed below represent the maximum volume in a tank unit during normal operations.

C.4.1.1 Codes and Standards for Tank System Construction

Specific standards for the manufacture of tanks and process systems installed in the 200 Area ETF are briefly discussed in the following sections. In addition to these codes and industrial standards, a seismic analysis for each tank and process system is required [WAC 173-303-806(4)(a)(xi)]. The seismic analysis was performed in accordance with UCRL-15910 *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards*, Section 4 (UCRL 1987). The results of the seismic analyses are summarized in the engineering assessment of the 200 Area ETF tank systems (*Final RCRA Information Needs Report*, Mausshardt 1995).

Storage and Treatment Tanks. The following tanks store and/or treat dangerous waste at the 200 Area ETF.

Tank name	Tank number
Surge tank	2025E-60A-TK-1
pH adjustment tank	2025E-60C-TK-1
Effluent pH adjustment tank	2025E-60C-TK-2
First RO feed tank	2025E-60F-TK-1
Second RO feed tank	2025E-60F-TK-2
Verification tanks (three)	2025E-60H-TK-1A/1B/1C
Secondary waste receiving tanks (two)	2025E-60I-TK-1A/1B
Evaporator Vapor Body Vessel	2025E-601-EV-1
Concentrate tanks (two)	2025E-60J-TK-1A/2025E-60J-TK-1B
Sump tanks (two)	2025E-20B-TK-1/2
Distillate flash tank	2025E-60I-TK-2
Load-In Station tank	2025ED-59A-TK-1

The relative location of these tanks is presented in Figure C.3. These tanks are maintained at or near atmospheric pressure. The codes and standards applicable to the design, construction, and testing of the above tanks and ancillary piping systems are as follows:

ASME - B31.3	Chemical Plant and Petroleum Refinery Piping (ASME 1990)
ASME Sect. VIII, Division I	Pressure Vessels (*Boiler and Pressure Vessel Code,* ASME 1992)
AWS - D1.1	Structural Welding Code - Steel (AWS 1992)
ANSI - B16.5	Pipe Flanges and Flanged Fittings (ANSI 1992)
ASME Sect. IX	Welding and Brazing Qualifications (*Boiler and Pressure Vessel Code,* ASME 1992)
API 620	Design and Construction of Large Welded Low Pressure Storage Tanks (API 1990)
AWWA - D100	Welded Steel Tanks for Water Storage (AWWA 1989)
AWWA - D103	Factory-Coated Bolted Steel Tanks for Water Storage (AWWA 1987)
AWWA - D120	Thermosetting Fiberglass-Reinforced Plastic Tanks (AWWA 1984)
ASTM-D3299	Filament Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion Resistant Tanks.

The application of these standards to the construction of 200 Area ETF tanks and independent verification of completed systems ensured that the tank and tank supports had sufficient structural strength and that seams and connections were adequate to ensure tank integrity. In addition, each tank met strict quality assurance requirements. Each tank, constructed offsite was tested for integrity and leak tightness before shipment to the Hanford Facility. Following installation, the systems were inspected for damage to ensure against leakage and to verify proper operation. If a tank was damaged during shipment or installation, leak tightness testing was repeated onsite.

C.4.1.2 Design Information for Tanks Located Outside of Building 2025-E

The load-In Station tanks, surge tank, and verification tanks are located outside building 2025-E. These tanks are located within concrete structures that provide secondary containment. Table C.6, 200 Area ETF Tank Systems Information, provides individual tank volumes, dimensions, and construction materials for tanks located outside building 2025-E.

Load-In Station Tanks (59A-TK-1/ 59A-TK-109/ 59A-TK-117) and Ancillary Equipment. Load-In Station tanks 59A-TK-109 and 59A-TK-117 are located outside of the Load-In Station building while Load-In Station tank 59A-TK-1 is located inside the Load-In Station building. Load-In Station tanks 59A-TK-109 and 59A-TK-117 have been permanently removed from service (refer to Addendum H, Closure Plan, section H.5.2.1). Ancillary equipment includes transfer pumps, filtration systems, a double encased, fiberglass transfer pipeline, level instruments for tanker trucks, and leak detection equipment. From the Load-In Station, aqueous waste can be routed to the surge tank or to the LERF through a double-encased line. Secondary containment for the Load-In Station tanks is discussed in Section C.4.3.1.2.

Surge Tank (60A-TK-1) and Ancillary Equipment. The surge tank is located outside on the south side of building 2025-E. Ancillary equipment to the surge tank includes two underground double encased (i.e., pipe-within-a-pipe) transfer lines connecting to LERF and three pumps for transferring aqueous waste to the primary treatment train. The surge tank is located at the south end of building 2025-E. The surge tank is insulated and the contents heated to prevent freezing. Eductors in the tank provide mixing.

Verification Tanks (60H-TK-1A/ 60H-TK-1B/ 60H-TK-1C) and Ancillary Equipment. The verification tanks are located outside and north of building 2025-E. For support, the tanks have a center post with a webbing of beams that extend from the center post to the sides of the tank. The roof is constructed of epoxy covered carbon steel that is attached to the cross beams of the webbing. The tank floor also is constructed of epoxy covered carbon steel and is sloped. Eductors are installed in each tank to provide mixing.

Ancillary equipment includes a return pump that provides circulation of treated effluent through the eductors. The return pump also recycles effluent back to the 200 Area ETF for retreatment and can provide service water for 200 Area ETF functions. Two transfer pumps are used to discharge treated effluent to SALDS or back to the LERF.

C.4.1.3 Design Information for Tanks Located Inside Building 2025-E

Most of the tanks and ancillary equipment that store or treat dangerous and/or mixed waste are located within building 2025-E. The structure serves as secondary containment for the tank systems. Table C.6, 200 Area ETF Tank Systems Information, provides individual tank volumes, dimensions, and construction materials for tanks located outside building 2025-E.

pH Adjustment Tank (60C-TK-1) and Ancillary Equipment. Ancillary equipment for the pH adjustment tank includes overflow lines to a sump tank and pumps to transfer waste to other units in the main treatment train.

Effluent pH Adjustment Tank (60C-TK-2) and Ancillary Equipment. Ancillary equipment for the effluent pH adjustment tank includes overflow lines to a sump tank and pumps to transfer waste to the verification tanks.

First and Second RO Feed Tanks and Ancillary Equipment. The first RO feed tank is a vertical, stainless steel tank with a round bottom. Conversely, the second RO feed tank is a rectangular vessel with the bottom of the tank sloping sharply to a single outlet in the bottom center. Each RO tank has a pump to transfer waste to the RO arrays. Overflow lines are routed to a sump tank.

Secondary Waste Receiving Tanks (60I-TK-1A/30I-TK-1B) and Ancillary Equipment. Two secondary waste receiving tanks collect waste from the units in the main treatment train, such as concentrate solution (retentate) from the RO units and regeneration solution from the IX columns. These are vertical, cylindrical tanks with a semi-elliptical bottom and a flat top. Ancillary equipment includes overflow lines to a sump tank and pumps to transfer aqueous waste to the Evaporator Vapor Body Vessel.

Evaporator Vapor Body Vessel (2025E-60I-EV-1) and Ancillary Equipment. The Evaporator Vapor Body Vessel, the principal component of the evaporation process, is a cylindrical pressure vessel with a conical bottom. Aqueous waste is fed into the lower portion of the vessel. The top of the vessel is domed and the vapor outlet is configured to prevent carryover of liquid during the foaming or bumping (violent boiling) at the liquid surface. The Evaporator Vapor Body Vessel is designed to meet the requirements of ASME Section VIII, Division I, Pressure Vessels (*Boiler and Pressure Vessel Code,* ASME 1992), and applicable codes and standards. The Evaporator Vapor Body Vessel piping meets the requirements of ASME B31.3, *Chemical Plant and Petroleum Refinery Piping* (ASME 1990).

The Evaporator Vapor Body Vessel includes the following ancillary equipment:

- Preheater
- Recirculation pump
- Waste heater with steam level control tank
- Concentrate transfer pump
- Entrainment separator
- Vapor compressor with silencers
- Silencer drain pump

Distillate Flash Tank (60I-TK-2) and Ancillary Equipment. The distillate flash tank is a horizontal tank. Ancillary equipment includes a pump to transfer the distillate to the surge tank for reprocessing.

Concentrate Tanks (2025E-60J-TK-1A and 2025E-60J-TK-1B) and Ancillary Equipment. Ancillary equipment for the two concentrate tanks includes overflow lines to a sump tank and pumps for recirculation and transfer.

Sump Tanks. Sump Tanks 1 and 2 are located below floor level. Both sump tanks are double-walled, rectangular tanks, placed inside concrete vaults. The sump tanks are located in pits below grade to allow gravity drain of solutions to the tanks. Each sump tank has two vertical pumps for transfer of waste to the secondary waste receiving tanks or to the surge tank for reprocessing.

C.4.1.4 Design Information for 200 Area Effluent Treatment Facility Process Units

As with the 200 Area ETF tanks, process units that treat and/or store dangerous and/or mixed waste are maintained at or near atmospheric pressure. These units were constructed to meet a series of design standards, as discussed in the following sections. Table C.7 presents the materials of construction and the ancillary equipment associated with these process units. All piping systems are designed to withstand the effects of internal pressure, weight, thermal expansion and contraction, and any pulsating flow. The design and integrity of these units are presented in the engineering assessment (*Final RCRA Information Needs Report,* Mausshardt 1995).

Filters. The Load-In Station fine and rough filter vessels (including the influent and auxiliary filters) are designed to comply with the ASME Section VIII, Division I, Pressure Vessels (*Boiler and Pressure Vessel Code,* ASME 1992). The application of these standards to the construction of the 200 Area ETF filter system and independent inspection ensure that the filter and filter supports have sufficient structural strength and that the seams and connections are adequate to ensure the integrity of the filter vessels.

Ultraviolet Oxidation (UV/OX) System. The UV/OX reaction chamber is designed to comply with manufacturers standards.

Degasification System. The codes and standards applicable to the design, fabrication, and testing of the degasification column are identified as follows:

- ASME - B31.3, Chemical Plant and Petroleum Refinery Piping (ASME 1990)
- AWS - D1.1, Structural Welding Code - Steel (AWS 1992)
- ANSI - B16.5, Pipe Flanges and Flanged Fittings (ANSI 1992)

RO System. The pressure vessels in the RO unit are designed to comply with ASME Section VIII, Division I, Pressure Vessels (*Boiler and Pressure Vessel Code,* ASME 1992), and applicable codes and standards.

Ion Exchange (Polishers). The IX columns are designed in accordance with ASME Section VIII, Division I, Pressure Vessels (*Boiler and Pressure Vessel Code,* ASME 1992), and applicable codes and standards. Polisher piping is fabricated of type 304 stainless steel or polyvinyl chloride (PVC) and meets the requirements of ASME B31.3, *Chemical Plant and Petroleum Refinery Piping* (ASME 1990).

Thin Film Dryer System. The thin film dryer is designed to meet the requirements of ASME Section VIII, Division I, *Boiler and Pressure Vessel Code* (Pressure Vessels, ASME 1992), and applicable codes and standards. The piping meets the requirements of ASME B31.3, *Chemical Plant and Petroleum Refinery Piping* (ASME 1990).

C.4.1.5 Integrity Assessments

The integrity assessment for 200 Area ETF (*Final RCRA Information Needs Report,* Mausshardt 1995) attests to the adequacy of design and integrity of the tanks and ancillary equipment to ensure that the tanks and ancillary equipment will not collapse, rupture, or fail over the intended life considering intended uses. For the Load-In Station tanks, a similar integrity assessment was performed (*200 Area Effluent BAT/AKART Implementation, ETF Truck Load-In Facility, Project W-291H, Integrity Assessment Report* [W-291H-IAR, KEH 1995], and *200 Area Effluent Treatment Facility Purgewater*

Unloading Facility Tank System Integrity Assessment [HNF-41604,2009]). Specifically, the assessment documents the following considerations:

- Adequacy of the standards used during design and construction of the facility.
- Characteristics of the solution in each tank.
- Adequacy of the materials of construction to provide corrosion protection from the solution in each tank.
- Results of the leak tests and visual inspections.

The results of these assessments demonstrate that tanks and ancillary equipment have sufficient structural integrity and are acceptable for storing and treating dangerous and/or mixed waste. The assessments also state that the tanks and building were designed and constructed to withstand a design-basis earthquake. Independent, qualified registered professional engineers certified these tank assessments.

The scope of the 200 Area ETF tank integrity assessment was based on characterization data from process condensate. To assess the effect that other aqueous waste might have on the integrity of the 200 Area ETF tanks, the chemistry of an aqueous waste will be evaluated for its potential to corrode a tank (e.g., chloride concentrations will be evaluated). The tank integrity assessment for the Load-In Station tanks (59A-TK-109/59A-TK-117) was based on characterization data from several aqueous waste streams. The chemistry of an aqueous waste stream not considered in the Load-In Station tank integrity assessment also will be evaluated for the potential to corrode a Load-In Station tank.

Consistent with the recommendations of the integrity assessment, a corrosion inspection program was developed. Periodic integrity assessments are scheduled for those tanks predicted to have the highest potential for corrosion. These inspections are scheduled annually or longer, based on age of the tank system, materials of construction, characteristics of the waste, operating experience, and recommendations of the initial integrity assessment. These 'indicator tanks' include the concentrate tanks, secondary waste receiving tanks, and verification tanks. One of each of these tanks will be inspected yearly to determine if corrosion or coating failure has occurred. Should significant corrosion or coating failure be found, an additional tank of the same type would be inspected during the same year.

In the case of the verification tanks, if corrosion or coating failure is found in the second tank, the third tank also will be inspected. If significant corrosion were observed in all three sets of tanks, the balance of the 200 Area ETF tanks would be considered for inspection. For tanks predicted to have lower potential for corrosion, inspections also are performed nonroutinely as part of the corrective maintenance program.

C.4.2 Additional Requirements for New Tanks

Procedures for proper installation of tanks, tank supports, piping, concrete, etc., are included in *Construction Specification, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (V-C018HC1-001, WHC 1992). For the Load-In Station tanks (59A-TK-109/ 59A-TK-117), procedures are included in the construction specifications in *Project W-291, 200 Area Effluent BAT/AKART Implementation ETF Truck Load-in Facility, Construction Specifications* (*W-291H-C2*, KEH 1994) and *Purgewater Unloading Facility Project Documentation* (HNF-39966, 2009). Following installation, an independent, qualified, registered professional engineer inspected the tanks and secondary containment. Deficiencies identified included damage to the surge tank, damage to the verification tank liners, and 200 Area ETF secondary containment concrete surface cracking. All deficiencies were repaired to the satisfaction of the engineer. The tanks and ancillary equipment were leak tested as part of acceptance of the system from the construction contractor. Information on the inspections and leak tests are included in the engineering assessment (*Final RCRA Information Needs Report,* Mausshardt 1995). No deficiencies were identified during installation of the Load-In Station tanks and ancillary equipment.

C.4.3 Secondary Containment and Release Detection for Tank Systems

This section describes the design and operation of secondary containment and leak detection systems at the 200 Area ETF.

C.4.3.1 Secondary Containment Requirements for All Tank Systems

The specifications for the preparation, design, and construction of the secondary containment systems at the 200 Area ETF are documented in *Design Construction Specification, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (V-C018HC1-001, (WHC 1992). The preparation, design, and construction of the secondary containment for the Load-In Station tanks (59A-TK-109/59A-TK-117) are provided in the construction specifications *200 Area Effluent BAT/AKART Implementation ETF Truck Load-In Facility, Construction Specifications,* [*W-291H-C2,* (KEH 1994], and *Purgewater Unloading Facility Project Documentation* [HNF-39966, 2009]). All systems were designed to national codes and standards. Constructing the 200 Area ETF per these specifications ensured that foundations are capable of supporting tank and secondary containment systems and that uneven settling and failures from pressure gradients should not occur.

C.4.3.1.1 Common Elements

The following text describes elements of secondary containment that are common to all 200 Area ETF tank systems. Details on the secondary containment for specific tanks, including leak detection systems and liquids removal, are provided in Section C.4.3.1.2.

Foundation and Construction. For the tanks within the 2025-E building, except for the sump tanks, secondary containment is provided by a coated concrete floor and a 6-inch rise (berm) along the containing walls. The double-wall construction of the sump tanks provides secondary containment. Additionally, trenches are provided in the floor that also provides containment and drainage of any liquid to a sump pit. For tanks outside building 2025-E, secondary containment also is provided with coated concrete floors in a containment pit (Load-In Station tanks) or surrounded by concrete dikes (the surge tank and verification tanks).

The transfer piping that carries aqueous waste into the 200 Area ETF is pipe-within-a-pipe construction, and is buried approximately 4 feet below ground surface. The pipes between the verification tanks and the verification tank pumps within building 2025-E are located in a concrete pipe trench.

For this discussion, there are five discrete secondary containment systems associated with the following tanks and ancillary equipment that treat or store dangerous waste:

- Load-In Station tanks
- Surge tank
- 2025-E Process Area
- Sump Tanks
- Verification tanks
- Transfer piping and pipe trenches

All of the secondary containment systems are designed with reinforcing steel and base and berm thickness to minimize failure caused by pressure gradients, physical contact with the waste, and climatic conditions. Classical theories of structural analysis, soil mechanics, and concrete and structural steel design were used in the design calculations for the foundations and structures. These calculations are maintained at the 200 Area ETF. In each of the analyses, the major design criteria from the following documents were included:

V-C018HC1-001, WHC 1992	*Design Construction Specification, Project C-018H, 242A Evaporator/PUREX Plant Process Condensate Treatment Facility*
DOE Order 6430.1A	General Design Criteria
HPS-SDC-4.1, Revision 11	"Design Load for Structures," *Hanford Plant Standards*
UCRL-15910 LLNL 1987	*Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards*, Lawrence Livermore National Laboratory, Livermore, California
UBC-91 UBC-97	Uniform Building Code, 1991 Edition (ICBO 1991) Uniform Building Code, 1997 Edition (ICC 1997, for Load-In Station tank 59A-TK-1)

The design and structural analysis calculations substantiate the structural designs in the referenced drawings. The conclusions drawn from these calculations indicate that the designs are sound and that the specified structural design criteria were met. This conclusion is verified in the independent design review that was part of the engineering assessment (*Final RCRA Information Needs Report* [Mausshardt 1995]; *200 Area Effluent BAT/AKART Implementation ETF Truck Load-In Facility, Construction Specifications,* [*W-291H-C2,* KEH 1994]; and *200 Area Effluent Treatment Facility Purgewater Unloading Facility Tank System Integrity Assessment* [HNF-41604, 2009]).

Containment Materials. The concrete floor consists of cast-in-place and preformed concrete slabs. All slab joints and floor and wall joints have water stops installed at the mid-depth of the slab. In addition, filler was applied to each joint.

Except for the sump tank vaults, all of the concrete surfaces in the secondary containment system, including berms, trenches, and pits, are coated with a chemical-resistant, high-solids, epoxy coating. This coating material is compatible with the waste being treated, and with the sulfuric acid, sodium hydroxide, and hydrogen peroxide additives to the process. The coating protects the concrete from contact with any chemical materials that might be harmful to concrete and prevents the concrete from being in contact with waste material. Table C.9 summarizes the specific types of primer and top coats specified for the concrete and masonry surfaces in the 200 Area ETF. The epoxy coating is considered integral to the secondary containment system for the tanks and ancillary equipment.

The concrete containment systems are maintained such that any cracks, gaps, holes, and other imperfections are repaired in a timely manner. Thus, the concrete containment systems do not allow spilled liquid to reach soil or groundwater. There are a number of personnel doorways and vehicle access points into the 2025-E Process Area. Releases of any spilled or leaked material to the environment from these access points are prevented by 6-inch concrete curbs, sloped areas of the floor (e.g., truck ramp), or trenches.

Containment Capacity and Maintenance. Each of these containment areas is designed to contain more than 100 percent of the volume of the largest tank in each respective system. Secondary containment systems for the surge tank, and the verification tanks, which are outside building 2025-E, also are large enough to include the additional volume from a 25-year, 24-hour storm event; i.e., 2 inches of precipitation.

Sprinkler System. The sprinkler system within the building 2025- E supplies firewater protection to the 2025-E Process Area and the 2025-E Container Storage Area. This system is connected to a site wide water supply system and has the capacity to supply sufficient water to suppress a fire. However, in the event of failure, the sprinkler system can be hooked up to another water source (e.g., tanker truck).

C.4.3.1.2 Secondary Containment Tank Systems

The following discussion presents a description of the individual containment systems associated with specific tank systems.

Load-In Station Tank Secondary Containment. Integral to the Load-In Station secondary containment is the Load-In Station pit, which receives drainage from all areas of the Load-In Station. The Load-In Station tank pit has12-inch-thick walls and a floor constructed of reinforced concrete and is sloped to drain solution to a sump. The depth of the pit varies with the slope of the floor, with an average thickness of about 3.5 feet. Load-In Station tanks 59A-TK-109 and 59A-TK-117 sit within this containment; but have been physically isolated from service (refer to Addendum H, Closure Plan, Section H.5.2.1). Leaks are detected by a leak detector that alarms locally, in the 200 Area ETF Control Room, and by visual inspection of the secondary containment. Alarms are monitored continuously in the 200 Area ETF Control Room during Load-In Station transfers and at least daily when there are no Load-In Station transfers occurring.

Adjacent to the pit is a 10-inch-thick reinforced concrete pad that serves as secondary containment for the Load-In Station tanker trucks, containers, transfer pumps, and filter system that serve as the first tanker truck unloading bay. The pad is inside the Load-In Station building 2025-ED and is 6 inches below grade with north and south walls gently sloped to allow truck access. The pad has a 3-inch drainpipe to route waste solution to the adjacent Load-In Station tank pit. The bay in the Load-In Station building is sloped to channel spills or leaks from containers to the Load-In Station pit. Table C.9 provides additional information on the protective coating for the concrete pad.

Load-In Station tank 59A-TK-1 is located on a 10-inch-thick reinforced concrete slab (Drawing H-2-817970) inside the Load-In Station building. The tank has a flat bottom that sits on a concrete slab in the secondary containment. Secondary containment for the tank, filter system, and unloading pumps and piping is provided by an epoxy coated catch basin with a capacity of about 900 gallons. The catch basin is sloped to route leaks and spills from the catch basin through a 6-inch-wide by 9-inch-deep trench to the adjacent truck unloading pad. This pad drains to the Load-In Station pit discussed above. The volume of the combined secondary containment of these two systems is 20,200 gallons, which is capable of holding the volume of tank 59A-TK-1.

Adjacent to tank 59A-TK-1 catch basin is a 10-inch-thick reinforced concrete pad that serves as the second tanker truck unloading bay. The pad is inside the metal Load-In Station building and has an 8 x 13-feet shallow, sloping pit to catch leaks during tanker truck unloading. The pit has a maximum depth of 2.4 inches and a 6-inch-wide by 2.4-inch-deep trench to route leaks to the adjacent tank 59A-TK-1 catch basin. The bay in the Load-In Station building is sloped to channel spills or leaks from containers to the Load-In Station pit. Coated concrete surfaces are provided for storage and unloading locations where spills and leaks could potentially occur.

Surge Tank Secondary Containment. The surge tank is mounted on a reinforced concrete ringwall. Inside the ringwall, the flat-bottomed tank is supported by a bed of compacted sand and gravel with a high-density polyethylene liner bonded to the ringwall. The liner prevents galvanic corrosion between the soil and the tank. The secondary containment is reinforced concrete with a 6-inch thick floor and an 8-inch thick dike. The secondary containment area shares part of the southern wall of the main 2025-E Process Area. The dike is 9.5 feet tall and provides 226,000 gallons of secondary containment.

The floor of the secondary containment slopes to a sump in the northwest corner of the containment area. Leaks into the secondary containment are detected by level instrumentation in the sump, which alarms in the 200 Area ETF Control Room and/or by routine visual inspections. Sump alarms are monitored continuously in the 200 Area ETF Control Room during 200 Area ETF processing operations and at least daily when 200 Area ETF is not processing waste. A sump pump is used to transfer solution in the secondary containment to a sump tank.

2025-E Process Area Secondary Containment. The 2025-E Process Area contains the tanks and ancillary equipment of the primary and secondary treatment trains, and has a jointed, reinforced concrete slab floor. The concrete floor of the 2025-E Process Area and sump tanks provide the secondary containment. This floor is a minimum of 6 inches thick. With doorsills 6 inches high, the 2025-E Process Area (including the 2025-E Truck Bay loading area and 2025-E Container Storage Area) has a containment volume of approximately 24,600 gallons (see Section C.3.4.3).

The floor of the 2025-E Process Area is sloped to drain liquids to two trenches that drain to sumps. Each trench is approximately 15 inches wide with a sloped trough varying from 15.5 to 30 inches deep. Leaks into the secondary containment are detected by routine visual inspections of the floor area near the tanks, ancillary equipment, and in the trenches.

A small dam was placed in the trench that comes from the thin film dryer room to contain minor liquid spills originating in the dryer room to minimize the spread of contamination into the 2025-E Process Area. The dryer room is inspected for leaks in accordance with the inspection schedule in Addendum I, Inspection Requirements. Operators clean up these minor spills by removing the liquid waste and decontaminating the spill area.

A small dam was also placed in the trench adjacent to the chemical feed skid when the chemical berm area was expanded to accommodate acid and caustic pumps, which were moved indoors from the top of the surge tank to resolve a safety concern. This dam was designed to contain minor spills originating in the chemical berm area and prevent them from entering the process sump.

The northwest corner of the 2025-E Process Area consists of a pump pit containing the pumps and piping for transferring treated effluent from the verification tanks to SALDS. The pit is built 4.5 feet below the 2025-E Process Area floor level and is sloped to drain to a trench built along its north wall that routes liquid to Sump Tank 2. Leaks into the secondary containment of the pump pit are detected by routine visual inspections.

Sump Tanks. The sump tanks support the secondary containment system, and collect waste from several sources, including:

- 2025-E Process Area drain trenches.
- Tank overflows and drains.
- Container washing water.
- Resin dewatering solution.
- Steam boiler blow down.
- Sampler system drains.

These double-contained tanks are located within unlined, concrete vaults. The sump tank levels are monitored by remote level indicators or through visual inspections from the sump covers. These indicators are connected to high- and low-level alarms that are monitored in the 200 Area ETF Control Room during ETF processing operations and at least daily when 200 Area ETF is not processing liquid waste. When a high-level alarm is activated, a pump is activated and the sump tank contents usually are routed to the secondary treatment train for processing. The contents also could be routed to the surge tank for treatment in the primary treatment train. In the event of an abnormally high inflow rate, a second sump pump is initiated automatically.

Verification Tanks Secondary Containment. The three verification tanks (60H-TK-1A /60H-TK-1B/ 60H-TK-1C) are each mounted on ringwalls with high-density polyethylene liners similar to the surge tank. The secondary containment for the three tanks is reinforced concrete with a 6-inch thick floor and an 8-inch thick dike. The dike extends up 8 feet to provide a containment of approximately 894,000 gallons exceeding the capacity of a single verification tank (See Table C.6).

The floor of the secondary containment slopes to a sump along the southern wall of the dike. Leaks into the secondary containment are detected by level instrumentation in the sump and/or by routine visual inspections. Sump alarms are monitored continuously in the 200 Area ETF Control Room during 200 Area ETF processing operations and at least daily when 200 Area ETF is not processing waste. A sump pump is used to transfer solution in the secondary containment to a sump tank.

C.4.3.2 Additional Requirements for Specific Types of Systems

This section addresses additional requirements in WAC 173-303-640 for double-walled tanks like the sump tanks and secondary containment for ancillary equipment and piping associated with the tank systems.

C.4.3.2.1 Double-Walled Tanks

The sump tanks are the only tanks in the 200 Area ETF classified as 'double-walled' tanks. These tanks are located in unlined concrete vaults and support the secondary containment system for the 2025-E Process Area. The sump tanks are equipped with a leak detector between the walls of the tanks that provide continuous monitoring for leaks. The leak detector alarms are monitored in the 200 Area ETF Control Room. These sump tank alarms are monitored continuously during 200 Area ETF processing operations and at least daily when 200 Area ETF is not processing waste. The inner tanks are contained completely within the outer shells. The tanks are contained completely within the concrete structure of building 2025-E so corrosion protection from external galvanic corrosion is not necessary.

C.4.3.2.2 Ancillary Equipment Secondary Containment

The secondary containment provided for the tanks and process systems also serves as secondary containment for the ancillary equipment associated with these systems.

Ancillary Equipment. Section C.4.3.1.2 describes the secondary containment systems that also serve most of the ancillary equipment within the 200 Area ETF. Between building 2025-E and the verification tanks, a pipeline trench provides secondary containment for four pipelines connecting the transfer pumps (i.e., discharge and return pumps) in the 200 Area ETF with the verification tanks (Figure C.2, Table C.7, and Table C.8). This concrete trench crosses under the road and extends from the verification tank pumps to the verification tanks. Treated effluent flows through these pipelines from the verification tank pumps to the verification tanks. The return pump is used to return effluent to the 200 Area ETF for use as service water or for reprocessing.

For all of the ancillary equipment housed within building 2025-E, the concrete floor, trenches, and berms form the secondary containment system. For the ancillary equipment of the surge tank and the verification tanks, secondary containment is provided by the concrete floors and dikes associated with these tanks. The concrete floor and pit provide secondary containment for the ancillary equipment of the Load-In Station tanks.

Transfer Piping and Pipe Trenches. The two buried transfer lines between LERF and the surge tank have secondary containment in a pipe-within-a-pipe arrangement. The 4-inch transfer line has an 8-inch outer pipe, while the 3-inch transfer, line has a 6-inch outer pipe. The pipes are fiberglass and are sloped towards the surge tank. The outer piping ends with a drain valve in the surge tank secondary containment.

These pipelines are equipped with leak detection located in the annulus between the inner and outer pipes; the leak detection equipment can continuously 'inspect' the pipelines during aqueous waste transfers. The alarms on the leak detection system are monitored in the 200 Area ETF Control Room. The 200 Area Control Room alarms are monitored continuously during aqueous waste transfers between LERF and the 200 Area ETF surge tank, and at least daily when no transfers are occurring. A low-volume air purge of the annulus is provided to prevent condensation buildup and minimize false alarms by the leak detection system. In the event that these leak detectors are not in service, the pipelines are inspected during transfers by opening a drain valve to check for solution in the annular space between the inner and outer pipe.

The 3-inch transfer line between the Load-In Station tanks and the surge tank has a 6-inch outer pipe in a pipe-within-a-pipe arrangement. The piping is made of fiberglass-reinforced plastic and slopes towards the Load-In Station tank secondary containment pit. The drain valve and leak detection system for the Load-In Station tank pipelines are operated similarly to the leak detection system for the LERF to 200 Area ETF pipelines.

As previously indicated, a reinforced concrete pipe trench provides secondary containment for piping under the roadway between the 200 Area ETF and the verification tanks (60H-TK-1A/60H-TK-1B/60H-TK-1C). Three 6-inch thick reinforced concrete partitions divide the trench into four portions and support metal gratings over the trench. Each portion of the trench is 4 feet wide, 2.5 feet deep, and slopes to route any solution present to 4-inch drain lines through the north wall of building 2025-E. These drain lines route solution to Sump Tank 2 in building 2025-E. The floor of the pipe trench is 12 inches thick and the sides are 6 inches thick. The concrete trenches are coated with water sealant and covered with metal gratings at ground level to allow vehicle traffic on the roadway.

C.4.4 Tank Management Practices

When an aqueous waste stream is identified for treatment or storage at 200 Area ETF, the generating unit is required to characterize the waste. Based on characterization data, the waste stream is evaluated to determine if the stream is acceptable for treatment or storage. Specific tank management practices are discussed in the following sections.

C.4.4.1.1 Rupture, Leakage, Corrosion Prevention

Most aqueous waste streams can be managed such that corrosion would not be a concern. For example, an aqueous waste stream with high concentrations of chloride might cause corrosion problems when concentrated in the secondary treatment train. One approach is to adjust the corrosion control measures in the secondary treatment train. An alternative might be to blend this aqueous waste through flow equalization in a LERF basin with another aqueous waste that has sufficient dissolved solids, such that the concentration of the chlorides in the secondary treatment train would not pose a corrosion concern.

Additionally, the materials of construction used in the tanks systems (Table C.6) make it unlikely that an aqueous waste would corrode a tank. For more information on corrosion prevention, refer to Addendum B, Waste Analysis Plan.

If operating experience suggests that most aqueous waste streams can be managed such that corrosion would not be a concern, operating practices and integrity assessment schedules and requirements will be reviewed and modified as appropriate.

When a leak in a tank system is discovered, the leak is immediately contained or stopped by isolating the leaking component. Following containment, the requirements of WAC 173-303-640(7), incorporated by reference, are followed. These requirements include repair or closure of the tank/tank system component, and certification of any major repairs.

C.4.4.2 Overfilling Prevention

Operating practices and administrative controls used at the 200 Area ETF to prevent overfilling a tank are discussed in the following paragraphs. The 200 Area ETF process is controlled by the MCS. The MCS monitors liquid levels in the 200 Area ETF tanks and has alarms that annunciate on high-liquid level to notify operators that actions must be taken to prevent overfilling of these vessels. As an additional precaution to prevent spills, many tanks are equipped with overflow lines that route solutions to Sump Tanks 1 and 2 to prevent the tank from overflowing into the secondary containment. These tanks include the pH adjustment tank; RO feed tanks, effluent pH adjustment tank, secondary waste receiving tanks, and concentrate tanks.

The following section discusses feed systems, safety cutoff devices, bypass systems, and pressure controls for specific tanks and process systems.

Tanks. All tanks are equipped with liquid level sensors that give a reading of the tank liquid volume. All of the tanks are equipped further with liquid level alarms that are actuated if the liquid volume is near the tank overflow capacity. In the actuation of the surge tank alarm, a liquid level switch trips, sending a signal to the valve actuator on the tank influent lines, and causing the influent valves to close. To prevent tank overflows when liquid level monitors are out of service, the tank system is placed in a safe configuration by isolating the tank from influent flow until the liquid level monitoring is restored to service or daily sump level readings may be taken for tanks that overflow to Sump Tanks 1 and 2.

The operating mode for each verification tank, i.e., receiving, holding, or discharging, can be designated through the MCS; modes also switch automatically. When the high-level set point on the receiving verification tank is reached, the flow to this tank is diverted and another tank becomes the receiver. The full tank is switched into verification mode. The third tank is reserved for discharge mode.

The liquid levels in the pH adjustment, first and second RO feed, and effluent pH adjustment tanks are maintained within predetermined operating ranges. Should any of the tanks overflow, the excess waste is piped along with any leakage from the feed pumps to a sump tank.

When waste in a secondary waste-receiving tank reaches the high-level set point, the influent flow of waste is redirected to the second tank. In a similar fashion, the concentrate tanks switch receipt modes when the high-level set point of one tank is reached.

Filter Systems. All filters at 200 Area ETF (i.e., the Load-In Station, rough, fine, and auxiliary filter systems) are in leak-tight steel casings. For the rough and fine filters, a high differential pressure, which could damage the filter element, activates a valve that shuts off liquid flow to protect the filter element from possible damage. To prevent a high-pressure situation, the filters are cleaned routinely with pulses of compressed air that force water back through the filter. Cleaning is terminated automatically by shutting off the compressed air supply if high pressure develops. The differential pressure across the auxiliary filters also is monitored. A high differential pressure in these filters would result in a system shutdown to allow the filters to be changed out.

The Load-In Station filtration system has pressure gauges for monitoring the differential pressure across each filter. A high differential pressure would result in discontinuing filter operation until the filter is replaced.

Ultraviolet Light/Oxidation System and Decomposers. A rupture disk on the inlet piping to each of the UV/OX reaction vessels relieves to the pH adjustment tank in the event of excessive pressure developing in the piping system. Should the rupture disk fail, the aqueous waste would trip the moisture sensor, shut down the UV lamps, and close the surge tank feed valve. Also provided is a level sensor to protect UV lamps against the risk of exposure to air. Should those sensors be actuated, the UV lamps would be shut down immediately.

The piping and valving for the hydrogen peroxide decomposers are configured to split the waste flow: half flows to one decomposer and half flows to the other decomposer. Alternatively, the total flow of waste can be treated in one decomposer or both decomposers can be bypassed. A safety relief valve on each decomposer vessel can relieve excess system pressure to a sump tank.

Degasification System. The degasification column is typically supplied aqueous waste feed by the pH adjustment tank feed pump. This pump transfers waste solution through the hydrogen peroxide decomposer, the fine filter, and the degasification column to the first RO feed tank.

The degasification column is designed for operation at a partial vacuum. A pressure sensor in the outlet of the column detects the column pressure. The vacuum in the degasification column is maintained by a blower connected to the vessel off gas system. The column is protected from extremely low pressure developed by the column blower by the use of an intake vent that is maintained in the open position during operation. The column liquid level is regulated by a flow control system with a high- and low-level alarm. Plate-type heat exchanger cools the waste solution fed to the degasification column.

RO System. The flow through the first and second RO stages is controlled to maintain constant liquid levels in the first and second stage RO feed tanks.

Polisher. Typically, two of the three columns are in operation (lead/lag) and the third (regenerated) column is in standby. When the capacity of the resin in the first column is exceeded, as detected by an increase in the conductivity of the column effluent, the third column, containing freshly regenerated IX resin, is brought online. The first column is taken offline, and the waste is rerouted to the second column, and to the third. Liquid level instrumentation and automatically operated valves are provided in the IX system to prevent overfilling.

Evaporator Vapor Body Vessel. Liquid level instrumentation in the secondary waste receiving tanks is designed to preclude a tank overflow. A liquid level switch actuated by a high-tank liquid level causes the valves to reposition, closing off flow to the secondary waste receiving tanks. Secondary containment for these tanks routes liquids to a sump tank.

Valves in the Evaporator Vapor Body Vessel feed line can be positioned to bypass the secondary waste around the Evaporator Vapor Body Vessel and to transfer the secondary waste to the concentrate tanks (2025E-60J-TK-1A/2025E-60J-TK-1B).

Thin Film Dryer. The two concentrate tanks alternately feed the thin film dryer. Typically, one tank serves as a concentrate waste receiver while the other tank serves as the dryer feed tank. One tank may serve as both concentrate waste receiver and dryer feed tank. Liquid level instrumentation prevents tank overflow by diverting the concentrate flow from the full concentrate tank to the other concentrate tank. Secondary containment for these tanks routes liquids to a sump tank.

An alternate route is provided from the concentrate receiver tank to the secondary waste receiving tanks. Dilute concentrate in the concentrate receiver tank can be reprocessed through the Evaporator Vapor Body Vessel by transferring the concentrate back to a secondary waste-receiving tank.

C.4.5 Labels or Signs

Each tank or process unit in the 200 Area ETF is identified by a nameplate attached in a readily visible location. Included on the nameplate are the equipment number and the equipment title. Those tanks that store or treat dangerous waste at the 200 Area ETF (Section C.4.1.1) are identified with a label, which reads *PROCESS WATER/WASTE*. The labels are legible at a distance of at least fifty feet or as appropriate for legibility within the 200 Area ETF. Additionally, these tanks bear a legend that identifies the waste in a manner, which adequately warns employees, emergency personnel, and the public of the major risk(s) associated with the waste being stored or treated in the tank system(s).

Caution plates are used to show possible hazards and warn that precautions are necessary. Caution signs have a yellow background and black panel with yellow letters and bear the word *CAUTION*. Danger signs show immediate danger and signify that special precautions are necessary. These signs are red, black, and white and bear the word *DANGER*.

Tanks and vessels containing corrosive chemicals are posted with black and white signs bearing the word *CORROSIVE*. *DANGER - UNAUTHORIZED PERSONNEL KEEP OUT* signs are posted on all exterior doors of building 2025-E, and on each interior door leading into the 2025-E Process Area. Tank ancillary piping is also labeled *PROCESS WATER* or *PROCESS LIQUID* to alert personnel which pipes in the 2025-E Process Area contains dangerous and/or mixed waste.

All tank systems holding dangerous waste are marked with labels or signs to identify the waste contained in the tanks. The labels or signs are legible at a distance of at least 50-feet and bear a legend that identifies the waste in a manner that adequately warns employees, emergency response personnel, and the public, of the major risk(s) associated with the waste being stored or treated in the tank system(s).

C.4.6 Air Emissions

Tank systems that contain extremely hazardous waste that is acutely toxic by inhalation must be designed to prevent the escape of such vapors. To date, no extremely hazardous waste has been managed in

200 Area ETF tanks and is not anticipated. However, the 200 Area ETF tanks have forced ventilation that draws air from the tank vapor spaces to prevent exposure of operating personnel to any toxic vapors that might be present. The vapor passes through a charcoal filter and two sets of high-efficiency particulate air filters before discharge to the environment. The Load-In Station tanks and verification tanks are vented to the atmosphere.

C.4.7 Management of Ignitable or Reactive Wastes in Tanks Systems

Although the 200 Area ETF is permitted to accept waste that is designated ignitable or reactive, such waste would be treated or blended immediately after placement in the tank system so that the resulting waste mixture is no longer ignitable or reactive. Aqueous waste received does not meet the definition of a combustible or flammable liquid given in National Fire Protection Association (NFPA) code number 30 (NFPA 1996).

The buffer zone requirements in NFPA-30, which require tanks containing combustible or flammable solutions be a safe distance from each other and from public way, are not applicable.

C.4.8 Management of Incompatible Wastes in Tanks Systems

The 200 Area ETF manages dilute solutions that can be mixed without compatibility issues. The 200 Area ETF is equipped with several systems that can adjust the pH of the waste for treatment activities. Sulfuric acid and sodium hydroxide are added to the process through the MCS for pH adjustment to ensure there will be no large pH fluctuations and adverse reactions in the tank systems.

C.5 LERF Surface Impoundment Operations

This section provides specific information on surface impoundment operations at the LERF, including descriptions of the liners and secondary containment structures, as required by WAC 173-303-650 and WAC 173-303-806(4)(d).

The LERF consists of three lined surface impoundments (basins) with a design capacity of 7.8 million gallons each. Each basin would overflow when the basin's volume reaches 9 million gallons. The dimensions of each basin at the anchor wall are approximately 338 x 278 feet. The typical top dimensions of the wetted area are approximately 292 x 233 feet, while the bottom dimensions are approximately 188 x 124 feet. Total depth from the top of the dike to the bottom of the basin is approximately 26.4 feet at the deepest point. The typical finished basin bottoms lie at about 15 feet below the initial grade and 593 feet above sea level. The dikes separating the basins have a typical height of 10 feet and typical top width of 38 feet around the perimeter of the impoundments.

C.5.1 List of Dangerous Waste

A list of dangerous and/or mixed aqueous waste that can be stored in LERF is presented in Addendum A. Addendum B, Waste Analysis Plan also provides a discussion of the types of waste that are managed in the LERF.

C.5.2 Construction, Operation, and Maintenance of Liner System

General information concerning the liner system is presented in the following sections. Information regarding loads on the liner, liner coverage, UV light exposure prevention, and location relative to the water table are discussed.

C.5.2.1 Liner Construction Materials

The LERF employs a double-composite liner system with a leachate detection, collection, and removal system between the primary and secondary liners. Each basin is constructed with an upper or primary liner consisting of a high-density polyethylene geomembrane laid over a bentonite carpet liner. The lower or secondary liner in each basin is a composite of a geomembrane laid over a layer of soil/bentonite admixture with a hydraulic conductivity less than 3.9E-08 inches per second. The synthetic liners extend up the dike wall to a concrete anchor wall that surrounds the basin at the top of the dike. A batten system bolts the layers in place to the anchor wall (Figure C.15).

Figure C.16 is a schematic cross-section of the liner system. The liner components, listed from the top to the bottom of the liner system, are the following:

- Primary 60-mil high-density polyethylene geomembrane
- Bentonite carpet liner
- Geotextile
- Drainage gravel (bottom) and geonet (sides)
- Geotextile
- Secondary 60-mil high-density polyethylene geomembrane
- Soil/bentonite admixture (36 inches on the bottom, 42 inches on the sides)
- Geotextile

The primary geomembrane, made of 60-mil (0.06 inch) high-density polyethylene, forms the basin surface that holds the aqueous waste. The secondary geomembrane, also 60-mil (0.06 inch) high-density polyethylene, forms a barrier surface for leachate that might penetrate the primary liner. The high-density polyethylene chemically is resistant to constituents in the aqueous waste and has a relatively high strength compared to other lining materials. The high-density polyethylene resin specified for the LERF contains carbon black, antioxidants, and heat stabilizers to enhance its resistance to the degrading effects of UV light. The approach to ensuring the compatibility of aqueous waste streams with the LERF liner materials and piping is discussed in Addendum B, Waste Analysis Plan.

Three geotextile layers are used in the LERF liner system. The layers are thin, nonwoven polypropylene fabric that chemically is resistant, highly permeable, and resistant to microbiological growth. The first two layers prevent fine soil particles from infiltrating and clogging the drainage layer. The second geotextile also provides limited protection for the secondary geomembrane from the drainage rock. The third geotextile layer prevents the mixing of the soil/bentonite admixture with the much more porous and granular foundation material.

A 12-inch-thick gravel drainage layer on the bottom of the basins between the primary and secondary liners provides a flow path for liquid to the leachate detection, collection, and removal system. A geonet (or drainage net) is located immediately above the secondary geomembrane on the basin sidewalls. The geonet functions as a preferential flow path for liquid between the liners, carrying liquid down to the gravel drainage layer and subsequently to the leachate sump. The geonet is a mesh made of high-density polyethylene, with approximately 0.5-inch openings.

The soil/bentonite layer is 36 inches thick on the bottom of the basins and (42 inches thick on the basin sidewalls; its permeability is less than 3.9E-08 inches per second. This composite liner design, consisting of a geomembrane laid over essentially impermeable soil/bentonite, is considered best available technology for solid waste landfills and surface impoundments. The combination of synthetic and clay liners is reported in the literature to provide the maximum protection from waste migration (*Flexible Membrane Liners for Solid and Hazardous Waste Landfills - A State of the Art Review*, Forseth and Kmet 1983).

A number of laboratory tests were conducted to measure the engineering properties of the soil/bentonite admixture, in addition to extensive field tests performed on three test fills constructed near the LERF site. For establishing an optimum ratio of bentonite to soil for the soil/bentonite admixture, mixtures of various ratios were tested to determine permeability and shear strength. A mixture of 12 percent bentonite was selected for the soil/bentonite liner and tests described in the following paragraphs demonstrated that the admixture meets the desired permeability of less than 3.9E-08 inches per second. Detailed discussion of test procedures and results is provided in *Report of Geotechnical Investigation, 242-A Evaporation and PUREX Interim Storage Basins, W-105, Project Number 90-1901* (Chen-Northern 1990).

Direct shear tests were performed according to ASTM D3080 test procedures (*Standard Test Method for Direct Shear Test of Soils Under Consolidation Drained Conditions*, ASTM 1990) on soil/bentonite samples of various ratios. Based on these results, the conservative minimum Mohr-Coulomb shear strength value of 30 degrees was estimated for a soil/bentonite admixture containing 12 percent bentonite.

The high degree of compaction of the soil/bentonite layer [92 percent per ASTM D1557 (*Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 feet-pound/feet)*, ASTM 1991)] was expected to maximize the bonding forces between the clay particles, thereby minimizing moisture transport through the liner. With respect to particle movement ('piping'), estimated fluid velocities in this low-permeability material are too low to move the soil particles. Therefore, piping is not considered a problem.

For the soil/bentonite layer, three test fills were constructed to demonstrate that materials, methods, and procedures used would produce a soil/bentonite liner that meets the EPA permeability requirement of less than 3.9E-08 inches per second. All test fills met the EPA requirements.
A thorough discussion of construction procedures, testing, and results is provided in *Report of Permeability Testing, Soil-bentonite Test Fill, KEH W-105, Project No 86-19005* (Chen-Northern 1991).

The aqueous waste stored in the LERF is typically a dilute mixture of organic and inorganic constituents. Though isolated instances of soil liner incompatibility have been documented in the literature (*Flexible Membrane Liners for Solid and Hazardous Waste Landfills - A State of the Art Review,* Forseth and Kmet 1983), these instances have occurred with concentrated solutions that were incompatible with the geomembrane liners in which the solutions were contained. Considering the dilute nature of the aqueous waste that is and will be stored in LERF and the moderate pH, and test results demonstrating the compatibility of the high-density polyethylene liners with the aqueous waste (9090 Test Results [WHC-SD-W105-TD-001, 1991]), gross failure of the soil/bentonite layer is not probable.

Each basin also is equipped with a floating very low-density polyethylene cover. The cover is anchored and tensioned at the concrete wall at the top of the dikes, using a patented mechanical tensioning system. Figure C.15 depicts the tension mechanism and the anchor wall at the perimeter of each basin. Additional information on the cover system is provided in Section C.5.2.5.

C.5.2.1.1 Material Specifications

Material specifications for the liner system and leachate collection system, including liners, drainage gravel, and drainage net are discussed in the following sections. Material specifications are documented in the *Final Specifications 242-A Evaporator and PUREX Interim Retention Basins* (W-105/83360/ER-0156, KEH 1990) and *Construction Specifications for 242-A Evaporator and PUREX Interim Retention Basins* (W-105, KEH 1990).

Geomembrane Liners. The high-density polyethylene resin for geomembranes for the LERF meets the material specifications listed in Table C.10. Key physical properties include thickness (60-mil [0.06-inch) and impermeability (hydrostatic resistance of over 450 pounds per square inch). Physical properties meet National Sanitation Foundation Standard 54 (*Flexible Membrane Liners,* NSF 1985). Testing to determine if the liner material is compatible with typical dilute waste solutions was performed and documented in *9090 Test Results* (WHC-SD-W105-TD-001, 1991).

Soil/Bentonite Liner. The soil/bentonite admixture consists of 11.5 to 14.5 percent bentonite mixed into well-graded silty sand with a maximum particle size of 0.187 inch (No. 4 sieve). Test fills were performed to confirm the soil/bentonite admixture applied at LERF has hydraulic conductivity less than 3.9E-08 inches per second, as required by WAC 173-303-650(2)(j) for new surface impoundments.

Bentonite Carpet Liner. The bentonite carpet liner consists of bentonite (90 percent sodium montmorillonite clay) in a primary backing of woven polypropylene with nylon filler fiber, and a cover fabric of open weave spunlace polyester. The montmorillonite is anticipated to retard migration of solution through the liner, exhibiting a favorable cation exchange for adsorption of some constituents (such as ammonium). Based on composition of the bentonite carpet and of the type of aqueous waste stored at LERF, no chemical attack, dissolution, or degradation of the bentonite carpet liner is anticipated.

Geotextile. The nonwoven geotextile layers consist of long-chain polypropylene polymers containing stabilizers and inhibitors to make the filaments resistant to deterioration from UV light and heat exposure. The geotextile layers consist of continuous geotextile sheets held together by needle punching. Edges of the fabric are sealed or otherwise finished to prevent outer material from pulling away from the fabric or raveling.

Drainage Gravel. The drainage layer consists of thoroughly washed and screened, naturally occurring rock meeting the size specifications for Grading Number 5 in Washington State Department of Transportation construction specifications (*Standard Specification* for *Road, Bridge, and Municipal Construction,* WSDOT 1988). The specifications for the drainage layer are given in Table C.11. Hydraulic conductivity tests (*Tests of Drainage Rock for the V797 Project, Hanford, Washington; Tests of Drainage Rock for the W105 Project, Hanford, Washington; Tests of Drainage Rock for the W105 Project, Hanford, Washington, CNI Word Order No. 2527,* Chen-Northern 1992) showed the drainage rock used at LERF met the sieve requirements and had a hydraulic conductivity of at least 0.4 inches per second, which exceeded the minimum of at least 0.04 inches per second required by WAC 173-303-650(2)(j) for new surface impoundments.

Geonet. The geonet is fabricated from two sets of parallel high-density polyethylene strands, spaced 0.5 inches center-to-center maximum to form a mesh with minimum two strands per 1 inch in each direction. The geonet is located between the liners on the sloping sidewalls to provide a preferential flow path for leachate to the drainage gravel and subsequently to the leachate sump.

Leachate Collection Sump. Materials used to line the 10 x 6 x 1-feet-deep leachate sump, at the bottom of each basin in the northwest corner, include [from top to bottom (Figure C.17)]:

- 1 inch high-density polyethylene flat stock (supporting the leachate riser pipe)
- Geotextile
- 60-mil (0.06 inch) high-density polyethylene rub sheet
- Secondary composite liner:
    - 60-mil (0.06 inch) high-density polyethylene geomembrane
- 3 feet of soil/bentonite admixture
- Geotextile

Specifications for these materials are identical to those discussed previously.

Leachate System Risers. Risers for the leachate system consist of 10-inch and 4-inch pipes from the leachate collection sump to the catch basin northwest of each basin (Figure C.17). The risers lay below the primary liner in a gravel-filled trench that also extends from the sump to the concrete catch basin (Figure C.17).

The risers are high-density polyethylene pipes fabricated to meet the requirements in ASTM D1248 (ASTM 1989). The 10-inch riser pipe is perforated every 8 inches with 0.5-inch holes around the diameter. Level sensors and leachate pump are inserted in the 10-inch riser pipe to monitor and remove leachate from the sump. To prevent clogging of the pump and piping with fine particulate, the end of the riser is encased in a gravel-filled box constructed of high-density polyethylene geonet and wrapped in geotextile. The 4-inch riser pipe is perforated every 4 inches with 1/4-inch holes around the diameter. A level detector is inserted in the 4-inch riser pipe.

Leachate Pump. A deep-well submersible pump, designed to deliver approximately 5 gallons per minute, is installed in the 10-inch leachate riser in each basin. Wetted parts of the leachate pump are made of 316L stainless steel, providing both corrosion resistance and durability.

C.5.2.1.2 Loads on Liner System

The LERF liner system is subjected to the following types of stresses.

Stresses from Installation or Construction Operations. Contractors were required to submit construction quality control plans that included procedures, techniques, tools, and equipment used for the construction and care of liner and leachate system. Methods for installation of all components were screened to ensure that the stresses on the liner system were kept to a minimum.

Calculations were performed to estimate the risk of damage to the secondary high-density polyethylene liner during construction (*Calculations for Liquid Effluent Retention Facility Part B Permit Application* [HNF-SD-LEF-TI-005, 1997]). The greatest risk expected was from spreading the gravel layer over the geotextile layer and secondary geomembrane. The results of the calculations show that the strength of the geotextile was sufficiently high to withstand the stress of a small gravel spreader driving on a minimum of 6 inches of gravel over the geotextile and geomembrane. The likelihood of damage to the geomembrane lying under the geotextile was considered low.

To avoid driving heavy machinery directly on the secondary liner, a 90-foot conveyer was used to deliver the drainage gravel into the basins. The gravel was spread and consolidated by hand tools and a bulldozer. The bulldozer traveled on a minimum thickness of 12 inches of gravel. Where the conveyer assembly was placed on top of the liner, cribbing was placed to distribute the conveyer weight. No heavy equipment was allowed for use directly in contact with the geomembranes.

Additional calculations were performed to estimate the ability of the leachate riser pipe to withstand the static and dynamic loading imposed by lightweight construction equipment riding on the gravel layer (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997). Those calculations demonstrated that the pipe could buckle under the dynamic loading of small construction equipment; therefore, the pipe was avoided by equipment during spreading of the drainage gravel.

Installation of synthetic lining materials proceeded only when winds were less than 15 miles per hour, and not during precipitation. The minimum ambient air temperature for unfolding or unrolling the high-density polyethylene sheets was 14°Fahrenheit [F], and a minimum temperature of 32°F was required for seaming the high-density polyethylene sheets. Between shifts, geomembranes and geotextile were anchored with sandbags to prevent lifting by wind. Calculations were performed to determine the appropriate spacing of sandbags on the geomembrane to resist lifting caused by 80-mile per hour winds (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997). All of the synthetic components contain UV light inhibitors and no impairment of performance is anticipated from the short-term UV light exposure during construction. Section C.5.2.4 provides further detail on exposure prevention.

During the laying of the soil/bentonite layer and the overlying geomembrane, moisture content of the admixture was monitored and adjusted to ensure optimum compaction and to avoid development of cracks.

C.5.2.1.3 Static and Dynamic Loads and Stresses from the Maximum Quantity of Waste

When a LERF basin is full, liquid depth is approximately 22.2 feet. Static load on the primary liner is roughly 9.1 pounds per square inch. Load on the secondary liner is slightly higher because of the weight of the gravel drainage layer. Assuming a density of 50 pounds per cubic foot for the drainage gravel [conservative estimate based on specific gravity of 2.65 (*Simplified Design of Building Foundations,* Ambrose 1988)], the secondary high-density polyethylene liner carries approximately 10.2 pounds per square inch of load when a basin is full.

Side slope liner stresses were calculated for each of the layers in the basin sidewalls and for the pipe trench on the northwest corner of each basin (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997). Results of these calculations indicate factors of safety against shear were 1.5 or greater for the primary geomembrane, geotextile, geonet, and secondary geomembrane.

Because the LERF is not located in an area of seismic concern, as identified in Appendix VI of 40 CFR 264 and WAC 173-303-282(6)(a)(I), discussion and calculation of potential seismic events are not required.

C.5.2.1.4 Stresses Resulting from Settlement, Subsidence, or Uplift

Uplift stresses from natural sources are expected to have negligible impact on the liner. Groundwater lies approximately 200 feet below the LERF, average annual precipitation is only 6.3 inches, and the average unsaturated permeability of the soils near the basin bottoms is high, ranging from about 2.2E-04 inches per second to about 0.4 inches per second (*Additional Information for Project W-105, Part B Permit Application*, Chen-Northern 1991). Therefore, no hydrostatic uplift forces are expected to develop in the soil underneath the basins. In addition, the soil under the basins consists primarily of gravel and sand, and contains few or no organic constituents. Therefore, uplift caused by gas production from organic degradation is not anticipated.

Based on the design of the soil-bentonite liner, no structural uplift stresses are present within the lining system (*Additional Information for Project W-105, Part B Permit Application*, Chen-Northern 1991).

Regional subsidence is not anticipated because neither petroleum nor extractable economic minerals are present in the strata underlying the LERF basins, nor is karst (erosive limestone) topography present.

Dike soils and soil/bentonite layers were compacted thoroughly and proof-rolled during construction. Calculation of settlement potential showed that combined settlement for the foundation and soil/bentonite layer is expected to be about 1.1 inches. Settlement impact on the liner and basin stability is expected to be minimal (*Additional Information for Project W-105, Part B Permit Application*, Chen-Northern 1991).

C.5.2.1.5 Internal and External Pressure Gradients

Pressure gradients across the liner system from groundwater are anticipated to be negligible. The LERF is about 200 feet above the seasonal high water table, which prevents buildup of water pressure below the liner. The native gravel foundation materials of the LERF are relatively permeable and free draining. The 2 percent slope of the secondary liner prevents the pooling of liquids on top of the secondary liner. Finally, the fill rate of the basins is slow enough (average 50 gallons per minute) that the load of the liquid waste on the primary liner is gradually and evenly distributed.

To prevent the buildup of gas between the liners, each basin is equipped with 21 vents in the primary geomembrane located above the maximum water level that allow the reduction of any excess gas pressure. Gas passing through these vents exit through a single pipe that penetrates the anchor wall into a carbon adsorption filter. This filter extracts nearly all of the organic compounds, ensuring that emissions to the air from the basins are not toxic.

C.5.2.2 Liner System Location Relative to High-Water Table

The lowest point of each LERF basin is the northwest corner of the sump, where the typical subgrade elevation is 574 feet above mean sea level. Based on data collected from the groundwater monitoring wells at the LERF site, the seasonal high-water table is located approximately 200 feet or more below the lowest point of the basins. This substantial thickness of unsaturated strata beneath the LERF provides ample protection to the liner from hydrostatic pressure because of groundwater intrusion into the soil/bentonite layer. Further discussion of the unsaturated zone and site hydrogeology is provided in Addendum D, Groundwater Monitoring Plan.

C.5.2.3 Liner System Foundation

Foundation materials are primarily gravels and cobbles with some sand and silt. The native soils onsite are derived from unconsolidated Holocene sediments. These sediments are fluvial and glaciofluvial sands and gravels deposited during the most recent glacial and postglacial event. Grain-size distributions and shape analyses of the sediments indicate that deposition occurred in a high-energy environment (*Report of Geotechnical Investigation, 242-A Evaporator and PUREX Interim Storage Basins, Hanford Federal Reservation,* W-105, Project No 90-1901, Chen-Northern 1990).

Analysis of five soil borings from the LERF site was conducted to characterize the natural foundation materials and to determine the suitability of onsite soils for construction of the impoundment dikes and determine optimal design factors. Well-graded gravel containing varying amounts of silt, sand, and cobbles comprises the layer in which the basins were excavated. This gravel layer extends to depths of 33 to 36 feet below land surface (*Report of Geotechnical Investigation, 242-A Evaporator and PUREX Interim Storage Basins, Hanford Federal Reservation,* W-105, Project No 90-1901, Chen-Northern 1990). The basins are constructed directly on the subgrade. Excavated soils were screened to remove oversize cobbles (greater than 6 inches in the largest dimension) and used to construct the dikes.

Settlement potential of the foundation material and soil/bentonite layer was found to be low. The foundation is comprised of undisturbed native soils. The bottom of the basin excavation lies within the well-graded gravel layer, and is dense to very dense. Below the gravel is a layer of dense to very dense poorly graded and well-graded sand. Settlement was calculated for the gravel foundation soils and for the soil/bentonite layer, under the condition of hydrostatic loading from 22.2 feet of fluid depth. The combined settlement for the soils and the soil/bentonite layer is estimated to be about 1.1 inches. This amount of settlement is expected to have minimal impact on overall liner or basin stability (*Additional Information for Project W-105, Part B Permit Application,* Chen-Northern 1991). Settlement calculations are provided in *Calculations for Liquid Effluent Retention Facility Part B Permit Application* (HNF-SD-LEF-TI-005, 1997).

The load bearing capacity of the foundation material, based on the soil analysis discussed previously, is estimated at about 69 pounds per square inch [maximum advisable presumptive bearing capacity (*Basic Soils Engineering,* Hough 1969)]. Anticipated static and dynamic loading from a full basin is estimated to be less than 13 pounds per square inch (Section C.5.2.1.3), which provides an ample factor of safety.

When the basins are empty, excess hydrostatic pressure in the foundation materials under the liner system theoretically could result in uplift and damage. However, because the native soil forming the foundations is unsaturated and relatively permeable, and because the water table is located at a considerable depth beneath the basins, any infiltration of surface water at the edge of the basin is expected to travel predominantly downward and away from the basins, rather than collecting under the excavation itself. No gas is expected in the foundation because gas-generating organic materials are not present.

Subsidence of undisturbed foundation materials is generally the result of fluid extraction (water or petroleum), mining, or karst topography. Neither petroleum, mineral resources, nor karst are believed to be present in the sediments overlying the Columbia River basalts. Potential groundwater resources do exist below the LERF. Even if these sediments were to consolidate from fluid withdrawal, their depth most likely would produce a broad, gently sloping area of subsidence that would not cause significant strains in the LERF liner system. Consequently, the potential for subsidence related failures are expected to be negligible.

Borings at the LERF site, and extensive additional borings in the 200 East Area, have not identified any significant quantities of soluble materials in the foundation soil or underlying sediments (*Hydrogeology of the 200 Are Low-Level Burial Grounds - An Interim* Report, PNL-6820, 1989). Consequently, the potential for sinkholes is considered negligible.

C.5.2.4 Liner System Exposure Prevention

Both primary and secondary geomembranes and the floating cover are stabilized with carbon black to prevent degradation from UV light. Furthermore, none of the liner layers experience long-term exposure to the elements. During construction, thin polyethylene sheeting was used to maintain optimum moisture content and provide protection from the wind for the soil/bentonite layer until the secondary geomembrane was laid in place. The secondary geomembrane was covered by the geonet and geotextile as soon as quality control testing was complete. Once the geotextile layer was completed, drainage material immediately was placed over the geotextile. The final (upper) geotextile layer was placed over the drainage gravel and immediately covered by the bentonite carpet liner. This was covered immediately, in turn, by the primary high-density polyethylene liner.

Both high-density polyethylene liners, geotextile layers, and geonet are anchored permanently to a concrete wall at the top of the basin berm. During construction, liners were held in place with many sandbags on both the basin bottoms and side slopes to prevent wind from lifting and damaging the materials. Calculations were performed to determine the amount of fluid needed in a basin to prevent wind lift damage to the primary geomembrane. Approximately 6 to 8 inches of solution are kept in each basin to minimize the potential for uplifting the primary liner (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997).

The entire lining system is covered by a very low-density polyethylene floating cover that is bolted to the concrete anchor wall. The floating cover prevents evaporation and intrusion from dust, precipitation, vegetation, animals, and birds. A patented tensioning system is employed to prevent wind from lifting the cover and automatically accommodate changes in liquid level in the basins. The cover tension mechanism consists of a cable running from the flexible geosynthetic cover over a pulley on the tension tower (located on the concrete anchor wall) to a dead man anchor. These anchors (blocks) simply hang from the cables on the exterior side of the tension towers. The anchor wall also provides for solid attachment of the liner layers and the cover, using a 1/4-inch batten and neoprene gasket to bolt the layers to the concrete wall, effectively sealing the basin from the intrusion of light, precipitation, and airborne dust (Figure C.15).

The floating cover, made of very low-density polyethylene with UV light inhibitors, is not anticipated to experience unacceptable degradation during the service life of the LERF. The very low-density polyethylene material contains carbon black for UV light protection, anti-oxidants to prevent heat degradation, and seaming enhancers to improve its ability to be welded. A typical manufacturer's limited warranty for weathering of very low-density polyethylene products is 20 years (Poly America, undated). This provides a margin of safety for the anticipated medium-term use of the LERF for aqueous waste storage.

The upper 11 to 15 feet of the sidewall liner also could experience stresses in response to temperature changes. Accommodation of thermal influences for the LERF geosynthetic layers is affected by inclusion of sufficient slack as the liners were installed. Calculations demonstrate that approximately 2.2 feet of slack is required in the long basin bottom dimension, 1.5 feet across the basin, and 1.1 feet from the bottom of the basin to the top of the basin wall (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997).

Thermal stresses also are experienced by the floating cover. As with the geomembranes, sufficient slack was included in the design to accommodate thermal contraction and expansion.

C.5.2.4.1 Liner Repairs During Operations

Should repair of a basin liner be required while the basin is in operation, a sufficient quantity of the basin contents will be transferred to the 200 Area ETF or another available basin to allow access for the repair activities. After the liner around the leaking or damaged section is cleaned, repairs to the geomembrane will be made as recommended by the liner vendor or others knowledgeable in liner repair; such as a professional engineer that has adequate knowledge and experience to make recommendations in liner repairs. The criteria for selecting a person or company to make liner repair recommendations is determined by the Permittees for the LERF basins. Selection criteria could include educational background, related experience, and professional qualifications.

C.5.2.4.2 Control of Air Emissions

The floating covers limit evaporation of aqueous waste and releases of volatile organic compounds into the atmosphere. To accommodate volumetric changes in the air between the fluid in the basin and the cover, and to avoid problems related to 'sealing' the basins too tightly, each basin is equipped with a carbon filter breather vent system. Any air escaping from the basins must pass through this vent, consisting of a pipe that penetrates the anchor wall and extends into a carbon adsorption filter unit.

C.5.2.5 Liner Coverage

The liner system covers the entire ground surface that underlies the retention basins. The primary liner extends up the side slopes to a concrete anchor wall at the top of the dike encircling the entire basin (Figure C.15).

C.5.3 Prevention of Overtopping

Overtopping prevention is accomplished through administrative controls and liquid-level instrumentation installed in each basin. The instrumentation includes local liquid-level indication as well as remote indication at the 200 Area ETF. Before an aqueous waste is transferred into a basin, administrative controls are implemented to ensure overtopping will not occur during the transfer. The volume of feed to be transferred is compared to the available volume in the receiving basin. The transfer is not initiated unless there is sufficient volume available in the receiving basin or a cut-off level is established. The transfer into the basin would be stopped when this cut-off level is reached.

In the event of a 25-year, 24-hour storm event, precipitation would accumulate on the basin covers. Through the self-tensioning design of the basin covers and maintenance of adequate freeboard, all accumulated precipitation would be contained on the covers and none would flow over the dikes or anchor walls. The 25-year, 24-hour storm is expected to deliver 2.1 inches of rain or approximately 2 feet of snow. Cover specifications include the requirement that the covers be able to withstand the load from this amount of precipitation. Because the cover floats on the surface of the fluid in the basin, the fluid itself provides the primary support for the weight of the accumulated precipitation. Through the cover self-tensioning mechanism, there is ample 'give' to accommodate the overlying load without overstressing the anchor and attachment points.

Rainwater and snow evaporate readily from the cover, particularly in the arid Hanford Facility climate, where evaporation rates exceed precipitation rates for most months of the year. The black color of the cover further enhances evaporation. Thus, the floating cover prevents the intrusion of precipitation into the basin and provides for evaporation of accumulated rain or snow.

C.5.3.1 Freeboard

Under current operating conditions, 2 feet of freeboard is maintained at each LERF basin, which corresponds to an operating level of 22.2 feet, or operating capacity 7.8 million gallons.

C.5.3.2 Immediate Flow Shutoff

The mechanism for transferring aqueous waste is either through pump transfers with on/off switches or through gravity transfers with isolation valves. These methods provide positive ability to shut off transfers immediately in the event of overtopping. Overtopping a basin during a transfer is very unlikely because the low flow rate into the basin provides long response times. At a flow rate of 75 gallons per minute, approximately 11 days would be required to fill a LERF basin from the maximum operating level to overflow level.

C.5.3.3 Outflow Destination

Aqueous waste in the LERF is transferred routinely to 200 Area ETF for treatment. However, should it be necessary to immediately empty a basin, the aqueous waste either would be transferred to the 200 Area ETF for treatment or transferred to another basin (or basins), whichever is faster. If necessary, a temporary pumping system may be installed to increase the transfer rate.

C.5.4 Structural Integrity of Dikes

The structural integrity of the dikes was certified attesting to the structural integrity of the dikes, signed by a qualified, registered professional engineer.

C.5.4.1 Dike Design, Construction, and Maintenance

The dikes of the LERF are constructed of onsite native soils, generally consisting of cobbles and gravels. Well-graded mixtures were specified, with cobbles up to 6 inches in the largest dimension, but not constituting more than 20 percent of the volume of the fill. The dikes are designed with a 3:1 (3 units horizontal to 1 unit vertical) slope on the basin side, and 2.25:1 on the exterior side. The dikes are approximately 26.9 feet high from the bottom of the basin, and 10 feet above grade.

Calculations were performed to verify the structural integrity of the dikes (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997). The calculations demonstrate that the structural strength of the dikes is such that, without dependence on any lining system, the sides of the basins can withstand the pressure exerted by the maximum allowable quantity of fluid in the impoundment. The dikes have a factor of safety greater than 2.5 against failure by sliding.

C.5.4.2 Dike Stability and Protection

In the following paragraphs, various aspects of stability for the LERF dikes and the concrete anchor wall are presented, including slope failure, hydrostatic pressure, and protection from the environment.

Failure in Dike/Impoundment Cut Slopes. A slope stability analysis was performed to determine the factor of safety against slope failure. The computer program 'PCSTABL5' from Purdue University, using the modified Janbu Method, was employed to evaluate slope stability under both static and seismic loading cases. One hundred surfaces per run were generated and analyzed. The assumptions used were as follows (*Additional Information for Project W-105, Part B Permit Application*, Chen-Northern 1991):

- Weight of gravel: 135 pounds per cubic foot.
- Maximum dry density of gravel: 144.5 pounds per cubic foot.
- Mohr-Coulomb shear strength angle for gravel: minimum 33 degrees.
- Weight of soil/bentonite: 100 pounds per cubic foot.
- Mohr-Coulomb shear strength angle for soil/bentonite: minimum 30 degrees.
- Slope: 3 horizontal: 1 vertical.
- No fluid in impoundment (worst case for stability).
- Soils at in-place moisture (not saturated conditions).

Results of the static stability analysis showed that the dike slopes were stable with a minimum factor of safety of 1.77 (*Additional Information for Project W-105, Part B Permit Application*, Chen-Northern 1991).

The standard horizontal acceleration required in the *Hanford Plant Standards*, "Standard Architectural-Civil Design Criteria, Design Loads for Facilities" (HPS-SDC-4.1, DOE-RL 1988), for structures on the Hanford Site is 0.12 g-force. Adequate factors of safety for cut slopes in units of this type generally are considered 1.5 for static conditions and 1.1 for dynamic stability (Site *Investigation Report, Non-Drag-Off Landfill* Site *Low-Level Burial Area No. 5, 200 West Area,* Golder 1989). Results of the stability analysis showed that the LERF basin slopes were stable under horizontal accelerations of 0.10 and 0.15 g-force, with minimum factors of safety of 1.32 and 1.17, respectively (*Additional Information for Project W-105, Part B Permit Application*, Chen-Northern 1991). Printouts from the PCSTABL5 program are provided in *Calculations for Liquid Effluent Retention Facility Part B Permit Application* (HNF-SD-LEF-TI-005, 1997).

Hydrostatic Pressure. Failure of the dikes due to buildup of hydrostatic pressure, caused by failure of the leachate system or liners, is very unlikely. The liner system is constructed with two essentially impermeable layers consisting of a synthetic layer overlying a soil layer with low-hydraulic conductivity. It would require a catastrophic failure of both liners to cause hydrostatic pressures that could endanger dike integrity. Routine inspections of the leachate detection system, indicating quantities of leachate removed from the basins, provide an early warning of leakage or operational problems that could lead to excessive hydrostatic pressure. A significant precipitation event (e.g., a 25-year, 24-hour storm) will not create a hydrostatic problem because the interior sidewalls of the basins are covered completely by the liners. The covers can accommodate this volume of precipitation without overtopping the dike (Section C.5.3), and the coarse nature of the dike and foundation materials on the exterior walls provides for rapid drainage of precipitation away from the basins.

Protection from Root Systems. Risk to structural integrity of the dikes because of penetrating root systems is minimal. Excavation and construction removed all vegetation on and around the impoundments, and native plants (such as sagebrush) grow very slowly. The large grain size of the cobbles and gravel used as dike construction material do not provide an advantageous germination medium for native plants. Should plants with extending roots become apparent on the dike walls, the plants will be controlled with appropriate herbicide application.

Protection from Burrowing Mammals. The cobble size materials that make up the dike construction material and the exposed nature of the dike sidewalls do not offer an advantageous habitat for burrowing mammals. Lack of vegetation on the LERF site discourages foraging. The risk to structural integrity of the dikes from burrowing mammals is therefore minimal. Periodic visual inspections of the dikes provide observations of any animals present. Should burrowing mammals be noted onsite, appropriate pest control methods such as trapping or application of rodenticides will be employed.

Protective Cover. Approximately 3 inches of crushed gravel serve as the cover of the exterior dike walls. This coarse material is inherently resistant to the effect of wind because of its large grain size. Total annual precipitation is low (6.3 inches) and a significant storm event (e.g., a 25-year, 24-hour storm) could result in about 2.1 inches of precipitation in a 24-hour period. The absorbent capacity of the soil exceeds this precipitation rate; therefore, the impact of wind and precipitation run-on to the exterior dike walls will be minimal.

C.5.5 Piping Systems

Aqueous waste from the 242-A Evaporator is transferred to the LERF using a pump located in the 242-A Evaporator and approximately 5,000 feet of pipe, consisting of a 3-inch carrier pipe within a 6-inch outer containment pipeline. Flow through the pump is controlled by a valve, at flow rates from 40 to 80 gallons per minute. The pipeline exits the 242-A Evaporator below grade and remains below grade at a minimum 14-feet depth for freeze protection, until the pipeline emerges at the LERF catch basin, at the corner of each basin. All piping at the catch basin that is less than 4 feet below grade is wrapped with electric heat tracing tape and insulated for protection from freezing.

The transfer line from the 242-A Evaporator is centrifugally cast, fiberglass-reinforced epoxy thermoset resin pressure pipe fabricated to meet the requirements of ASME D2997, *Standard Specification for Centrifigally Cast Reinforced Thermosetting Resin Pipe* (ASME 1984). The 3-inch carrier piping is centered and supported within 6-inch containment piping. Pipe supports are fabricated of the same material as the pipe, and meet the strength requirements of ANSI B31.3, *Process Piping Guide* (ANSI 1987) for dead weight, thermal, and seismic loads. A catch basin is provided at the northwest corner of each basin where piping extends from the basin to allow for basin-to-basin and basin-to-200 Area ETF liquid transfers. Drawing H-2-88766, Sheets 1 through 4, provide schematic diagrams of the piping system at LERF. Drawing H-2-79604 provides details of the piping from the 242-A Evaporator to LERF.

C.5.5.1 Secondary Containment System for Piping

The 6-inch containment piping encases the 3-inch carrier pipe from the 242-A Evaporator to the LERF. All of the piping and fittings that are not directly over a catch basin or a basin liner are of this pipe-within-a-pipe construction. A catch basin is provided at the northwest corner of each basin where the inlet pipes, leachate risers, and transfer pipe risers emerge from the basin.

The catch basin consists of an 8-inch-thick concrete pad at the top of the dike. The perimeter of the catch basin has an 8-inch-high curb and the concrete is coated with a chemical resistant epoxy sealant. The concrete pad is sloped so that any leaks or spills from the piping or pipe connections will drain into the basin. The catch basin provides an access point for inspecting, servicing, and operating various systems such as transfer valving, leachate level instrumentation and leachate pump. Drawing H-2-79593 provides a schematic diagram of the catch basins.

C.5.5.2 Leak Detection System

During operation, the 242-A Evaporator receives dilute tank waste directly from the Tank Farms, treats waste by evaporation, and returns the concentrated waste to Tank Farms. The process condensate that is generated is transferred to LERF. Single-point electronic leak detection elements are installed along the transfer line at 1,000-feet intervals. The leak detection elements are located in the bottom of specially designed test risers. Each sensor element employs a conductivity sensor, which is connected to a cable leading back to the 242-A Evaporator Control Room. If a leak develops in the carrier pipe, fluid will travel down the exterior surface of the carrier pipe or the interior of the containment pipe. As moisture contacts a sensor unit, an alarm sounds in the 200 Area ETF Control Room, which is monitored continuously when the 242-A Evaporator is transferring liquids to LERF. If the alarm sounds, 200 Area ETF Operations staff troubleshoots the alarm and, upon verification of a leak, requests that the pump located in the 242-A Evaporator be shut down to stop the flow of process condensate through the transfer line. The 242-A Evaporator has limited surge capacity, and its operation is closely tied to supporting Tank Farm operations. The flow of process condensate to LERF is not stopped automatically by indication of a possible leak in the primary transfer line. A low-volume air purge of the annulus between the carrier pipe and the containment pipe is provided to prevent condensation buildup and minimize false alarms by the leak detection elements.

The catch basins have conductivity leak detectors that alarm in the 200 Area ETF Control Room. Leak detector alarms are monitored in the 200 Area Control Room continuously during aqueous waste transfers and at least daily when no transfers are occurring. Leaks into the catch basins drain back to the basin through a 2-inch drain on the floor of the catch basin.

C.5.5.3 Certification

Although an integrity assessment is not required for piping associated with surface impoundments, an assessment of the transfer liner was performed, including a hydrostatic leak/pressure test at 150 pounds per square inch gauge. A statement by an independent, qualified, registered professional engineer attesting to the integrity of the piping system is included in *Integrity Assessment Report for the 242-A Evaporator/LERF Waste Transfer Piping, Project W105* (WHC-SD-WM-ER-112, 1993), along with the results of the leak/pressure test.

C.5.6 Double Liner and Leak Detection, Collection, and Removal System

The double-liner system for LERF is discussed in Section C.5.2. The leachate detection, collection, and removal system (Figures C.16 and C.17) as designed and constructed to remove leachate that might permeate the primary liner. System components for each basin include:

- 12-inch layer of drainage gravel below the primary liner at the bottom of the basin.
- Geonet below the primary liner on the sidewalls to direct leachate to the gravel layer.
- 10 x 6 x 1-feet)-deep leachate collection sump consisting of a 1-inch high-density polyethylene flat stock, geotextile to trap large particles in the leachate, and 60-mil (0.06 inch) high-density polyethylene rub sheet set on the secondary liner.
- 10-inch and 4-inch perforated leachate high-density polyethylene riser pipes from the leachate collection sump to the catch basin northwest of the basin.
- Leachate collection sump level instrumentation installed in the 4-inch riser pipe.
- Level sensors, submersible leachate pump, and 1.5-inch fiberglass-reinforced epoxy thermoset resin pressure piping installed in the 10-inch riser pipe.
- Piping at the catch basin to route the leachate through 1.5-inch high-density polyethylene pipe back to the basins.

The bottom of the basins has a two percent slope to allow gravity flow of leachate to the leachate collection sump. This exceeds the minimum of 1 percent slope required by WAC 173-303-650(j) for new surface impoundments. Material specifications for the leachate collection system are given in Section C.5.2.1.1.

Calculations demonstrate that fluid from a small hole (0.08 inch) (*Requirements for Hazardous Waste Landfill Design, Construction, and Closure,* EPA/625/4-89/022, 1989, p. 122) at the furthest end of the basin, under a low head situation, would travel to the sump in less than 24 hours (*Calculations for Liquid Effluent Retention Facility Part B Permit Application,* HNF-SD-LEF-TI-005, 1997). Additional calculations indicate the capacity of the pump to remove leachate is sufficient to allow time to readily identify a leak and activate emergency procedures (HNF-SD-LEF-TI-005, 1997).

The fluid level in each leachate sump is required to be maintained below 13 inches to prevent significant liquid backup into the drainage layer. The leachate pump is activated when the liquid level in the sump reaches about 11 inches, and is shut off when the sump liquid level reaches about 7 inches. This operation may be done either manually or automatically. Liquid level control is accomplished with conductivity probes that trigger relays selected specifically for application to submersible pumps and leachate fluids. A flow meter/totalizer on the leachate return pipe measures fluid volumes pumped and pumping rate from the leachate collection sumps, and indicates volume and flow rate on local readouts. In addition, a timer on the leachate pump tracks the cumulative pump operating time. Other instrumentation provided is real-time continuous level monitoring with readout at the catch basin. Leachate levels are monitored at least weekly. A sampling port is provided in the leachate piping system at the catch basin. The leak rate through the primary liner can be calculated using two methods: 1) measured as the leachate flow meter/totalizer readings (flow meters/totalizers are located on the outflow line from the collection sumps in the bottom of the LERF basins), and 2) calculated using the pump operating time readings multiplied by the pump flow rate (the pump runs at a constant flow rate). Calculations using either method are sufficient for compliance. For more information on inspections, refer to Addendum I.

The stainless steel leachate pump delivers 5 gallons per minute. The leachate pump returns draw liquid from the sump via 1.5-inch pipe and discharges into the basin through 1.5-inch high-density polyethylene pipe.

C.5.7 Construction Quality Assurance

The construction quality assurance plan and complete report of construction quality assurance inspection and testing results are provided in *242-A Evaporator Interim Retention Basin Construction Quality Assurance Plan* (CQAPLN2.QS.1149, Rev. 4, KEH 1991). A general description of construction quality assurance procedures is outlined in the following paragraphs.

For excavation of the basins and construction of the dikes, regular inspections were conducted to ensure compliance with procedures and drawings, and compaction tests were performed on the dike soils.

For the soil/bentonite layer, test fills were first conducted in accordance with EPA guidance to demonstrate compaction procedures and to confirm compaction and permeability requirements can be met. The ratio of bentonite to soil and moisture content was monitored; lifts did not exceed 6 inches before compaction, and specific compaction procedures were followed. Laboratory and field tests of soil properties were performed for each lift and for the completed test fill. The same suite of tests was conducted for each lift during the laying of the soil/bentonite admixture in the basins.

Geotextiles and geomembranes were laid in accordance with detailed procedures and quality assurance programs provided by the manufacturers and installers. These included destructive and nondestructive tests on the geomembrane seams, and documentation of field test results and repairs.

C.5.8 Proposed Action Leakage Rate and Response Action Plan

An action leakage rate limit is established where action must be taken due to excessive leakage from the primary liner. The action leak rate is based on the maximum design flow rate the leak detection system can remove without the fluid head on the bottom liner exceeding 12 inches. The limiting factor in the leachate removal rate is the hydraulic conductivity of the drainage gravel. An action leakage rate (also called the rapid or large leak rate) of 2,100 gallons per acre per day was calculated for each basin (*Calculation of the Rapid or Large Leak Rate for LERF Basins in the 200 East Area,* WHC-SD-EN-TI-009, 1992).

When it is determined that the action leakage rate has been exceeded, the response action plan will follow the actions in WAC 173-303-650(11)(b) and (c), which includes notification of Ecology in writing within 7 days, assessing possible causes of the leak, and determining whether waste receipt should be curtailed and/or the basin emptied.

C.5.9 Dike Structural Integrity Engineering Certification

The structural integrity of the dikes was certified attesting to the structural integrity of the dikes, signed by a qualified, registered professional engineer.

C.5.10 Management of Ignitable, Reactive, or Incompatible Wastes

Although ignitable or reactive aqueous waste might be received in small quantities at LERF, such aqueous waste is mixed with dilute solutions in the basins, removing the ignitable or reactive characteristics. For compatibility requirements with the LERF liner, refer to Addendum B, Waste Analysis Plan.

C.6 Air Emissions Control

This section addresses the 200 Area ETF requirements of Air Emission Standards for Process Vents, under 40 CFR 264, Subpart AA (WAC 173-303-690 incorporated by reference) and Subpart CC. The requirements of 40 CFR 264, Subpart BB (WAC 173-303-691) is not applicable because aqueous waste with 10 percent or greater organic concentration would not be acceptable for processing at the ETF.

C.6.1 Applicability of Subpart AA Standards

The Evaporator Vapor Body Vessel and thin film dryer perform operations that specifically require evaluation for applicability of WAC 173-303-690. Aqueous waste in these units routinely contains greater than 10 parts per million concentrations of organic compounds and are, therefore, subject to air emission requirements under WAC 173-303-690. Organic emissions from all affected process vents on the Hanford Facility must be less than 3 pounds per hour and 3.1 tons per year, or control devices must be installed to reduce organic emissions by 95 percent.

The vessel off gas system provides a process vent system. This system provides a slight vacuum on the 200 Area ETF process vessels and tanks (see Section C.2.5.2). Two vessel vent header pipes combine and enter the vessel off gas system filter unit consisting of a demister, electric heater, prefilter, high-efficiency particulate air filters, activated carbon absorber, and two exhaust fans (one fan in service while the other is backup). The vessel off gas system filter unit is located in the high-efficiency particulate air filter room west of the 2025-E Process Area. The vessel off gas system exhaust discharges into the larger building ventilation system, with the exhaust fans and stack located outside and immediately west of the ETF. The exhaust stack discharge point is 51 feet above ground level.

The annual average flow rate for the 200 Area ETF stack (which is the combined vessel off gas and building exhaust flow rates) is 56,000 cubic feet per minute with a total annual flow of approximately 2.9E+10 cubic feet. During waste processing, the airflow through just the vessel off gas system is about 800 standard cubic feet per minute.

Organic emissions occur during waste processing, which occurs less than 310 days each year (i.e., 85 percent operating efficiency). This operating efficiency represents the maximum annual operating time for the ETF, as shutdowns are required during the year for planned maintenance outages and for reconfiguring the 200 Area ETF to accommodate different aqueous waste.

C.6.2 Process Vents - Demonstrating Compliance

This section outlines how the 200 Area ETF complies with the requirements and includes a discussion of the basis for meeting the organic emissions limits, calculations demonstrating compliance, and conditions for reevaluation.

C.6.2.1 Basis for Meeting Limits/Reductions

The 242-A Evaporator and the 200 Area ETF are currently the only operating TSD units that contribute to the Hanford Facility volatile organic emissions under 40 CFR 264, Subpart AA. The combined release rate is currently well below the threshold of 3 pounds per hour and 3.1 tons per year of volatile organic compounds. As a result, the 200 Area ETF meets these standards without the use of air pollution control devices.

The amount of organic emissions could change as waste streams are changed, or TSD units are brought online or are deactivated. The organic air emissions summation will be re-evaluated periodically as condition warrants. Operations of the TSD units operating under 40 CFR 264, Subpart AA, will be controlled to maintain Hanford Facility emissions below the threshold limits or pollution control device(s) will be added, as necessary, to achieve the reduction standards specified under 40 CFR 264, Subpart AA.

C.6.2.2 Demonstrating Compliance

Calculations to determine organic emissions are performed using the following assumptions:

- Maximum flow rate from LERF to 200 Area ETF is 150 gallons per minute.
- Emissions of organics from tanks and vessels upstream of the UV/OX process are determined from flow and transfer rates given in *Clean Air Act Requirements, WAC 173-400, and As-built Documentation, Project C-018H, 242-A Evaporator/PUREX Plant Process Condensate Treatment Facility* (Adtechs 1995).
- UV/OX reaction rate constants and residence times are used to determine the amount of organics, which are destroyed in the UV/OX process. These constants are given in *200 Area Effluent Treatment Facility Delisting Petition* (DOE/RL-92-72, 1993).
- All organic compounds that are not destroyed in the UV/OX process are assumed to be emitted from the tanks and vessels into the vessel off gas system.
- No credit for removal of organic compounds in the vessel off gas system carbon absorber unit is taken. The activated carbon absorbers are used if required to reduce organic emissions.

The calculation to determine organic emissions consists of the following steps:

1. Determine the quantity of organics emitted from the tanks or vessels upstream of the UV/OX process, using transfer rate values.
2. Determine the concentration of organics in the waste after the UV/OX process using UV/OX reaction rates and residence times. If the 200 Area ETF is configured such that the UV/OX process is not used, a residence time of zero is used in the calculations (i.e., none of the organics are destroyed).
3. Assuming all the remaining organics are emitted, determine the rate, which the organics are emitted using the feed flow rate and the concentrations of organics after the UV/OX process.
4. The amount of organics emitted from the vessel off gas system is the sum of the amount calculated in steps 1 and 3.

The organic emission rates and quantity of organics emitted during processing are determined using these calculations and are included in the Hanford Facility Operating Record, LERF and 200 Area ETF file.

C.6.2.3 Reevaluating Compliance with Subpart AA Standards

Calculations to determine compliance with Subpart AA will be reviewed when any of the following conditions occur at the 200 Area ETF:

- Changes in the maximum feed rate to the 200 Area ETF (i.e., greater than the 150 gallons per minute flow rate).
- Changes in the configuration or operation of the 200 Area ETF that would modify the assumptions given in Section C.6.2.2 (e.g., taking credit for the carbon absorbers as a control device).
- Annual operating time exceeds 310 days.

C.6.3 Applicability of Subpart CC Standards

The air emission standards of 40 CFR 264, Subpart CC apply to tank, surface impoundment, and container storage units that manage wastes with average volatile organic concentrations equal to or exceeding 500 parts per million by weight, based on the hazardous waste composition at the point of origination (61 FR 59972). However, TSD units that are used solely for management of mixed waste are exempt. Mixed waste is managed at the LERF and 200 Area ETF and dangerous waste could be treated and stored at these TSD units.

TSD owner/operators are not required to determine the concentration of volatile organic compounds in a hazardous waste if the wastes are placed in waste management units that employ air emission controls that comply with the Subpart CC standards. Therefore, the approach to Subpart CC compliance at the LERF and 200 Area ETF is to demonstrate that the LERF and 200 Area ETF meet the Subpart CC control standards (40 CFR 264.1084 – 40 CFR 264.1086).

C.6.3.1 Demonstrating Compliance with Subpart CC for Tanks

Since the 200 Area ETF tanks already have process vents regulated under 40 CFR 264, Subpart AA (WAC 173-303-690), they are exempt from Subpart CC [40 CFR 264.1080(b)(8)].

C.6.3.2 Demonstrating Compliance with Subpart CC for Containers

Container Level 1 and Level 2 standards are met at the 200 Area ETF by managing all dangerous and/or mixed wastes in U.S. Department of Transportation containers [40 CFR 264.1086(f)]. Level 1 containers are those that store more than 3.5 cubic feet and less than or equal to 16 cubic feet. Level 2 containers are used to store more than 16 cubic feet of waste, which are in 'light material service'. Light material service is defined where a waste in the container has one or more organic constituents with a vapor pressure greater than 0.04 pounds per square inch at 68°F, and the total concentration of such constituents is greater than or equal to 20 percent by weight.

The monitoring requirements for Level 1 and Level 2 containers must include a visual inspection when the container is received at the 200 Area ETF, when waste is initially placed in the container, and at least once every 12 months when stored onsite for 1 year or more.

If compliant containers are not used at the 200 Area ETF, alternate container management practices are used that comply with the Level 1 standards. Specifically, the Level 1 standards allow for a "container equipped with a cover and closure devices that form a continuous barrier over the container openings such that when the cover and closure devices are secured in the closed position there are no visible holes, gaps, or other open spaces into the interior of the container. The cover may be a separate cover installed on the container...or may be an integral part of the container structural design… [40 CFR 264.1086(c)(1)(ii)]. An organic-vapor-suppressing barrier, such as foam, may also be used [40 CFR 264.1086(c)(1)(iii)]. Section C.3 provides detail on container management practices at the 200 Area ETF.

Container Level 3 standards apply when a container is used for the "treatment of a hazardous waste by a waste stabilization process" [40 CFR 264.1086(2)]. Because treatment in containers using the stabilization process is not provided at the 200 Area ETF, these standards do not apply.

C.6.3.3 Demonstrating Compliance with Subpart CC for Surface Impoundments

The Subpart CC emission standards are met at LERF using a floating membrane cover that is constructed of very-low-density polyethylene that forms a continuous barrier over the entire surface area

[40 CFR 264.1085(c)]. This membrane has both organic permeability properties equivalent to a high-density polyethylene cover and chemical/physical properties that maintain the material integrity for the intended service life of the material. The additional requirements for the floating cover at the LERF have been met (Section C.5.2.4).

C.7 Engineering Drawings

C.7.1 Liquid Effluent Retention Facility

Drawings of the containment systems at the LERF are summarized in Table C.2. Because the failure of these containment systems at LERF could lead to the release of dangerous waste into the environment, modifications that affect these containment systems will be submitted to the Washington State Department of Ecology, as a Class 1, 2, or 3 Permit modification, as required by WAC 173-303-830.

Table C.2. Liquid Effluent Retention Facility Containment System

LERF System	Drawing Number	Drawing Title
Bottom Liner	H-2-79590, Sheet 1	Civil Plan, Sections & Det; Cell Basin Bottom Liner
Top Liner	H-2-79591, Sheet 1	Civil Plan, Sections & Det; Cell Basin Top Liner
Catch Basin	H-2-79593, Sheet 1, 3-5	Civil Plan, Sections & Det; Catch Basin

The drawings identified in Table C.3 illustrate the piping and instrumentation configuration within LERF, and of the transfer piping systems between the LERF and the 242-A Evaporator. These drawings are provided for general information, and to demonstrate the adequacy of the design of the LERF as a surface impoundment.

Table C.3. Liquid Effluent Retention Facility Piping and Instrumentation

LERF System	Drawing Number	Drawing Title
Transfer Piping to 242-A Evaporator	H-2-79604, Sheet 1	Piping Plot & Key Plans; 242-A Evap Cond Stream
LERF Piping and Instrumentation	H-2-88766, Sheet 1	P&ID; LERF Basin & ETF Influent Evaporator
	H-2-88766, Sheet 2	P&ID; LERF Basin & ETF Influent
	H-2-88766, Sheet 3	P&ID; LERF Basin & ETF Influent
	H-2-88766, Sheet 4	P&ID; LERF Basin & ETF Influent
Legend	H-2-89351, Sheet 1	Piping & Instrumentation Diagram - Legend

C.7.2 200 Area Effluent Treatment Facility

Drawings of the secondary containment systems for the 200 Area ETF containers, and tanks and process units, and for the Load-In Station tanks are summarized in Table C.4. Because the failure of the secondary containment systems could lead to the release of dangerous waste into the environment, modifications, which affect the secondary containment systems, will be submitted to the Washington State Department of Ecology, as a Class 1, 2, or 3 Permit modification, as required by WAC 173-303-830.

Table C.4. Building 2025-E and Load-In Station Secondary Containment Systems

200 Area ETF Process Unit	Drawing Number	Drawing Title
Surge Tank, Process/2025-E Container Storage Areas and Trenches - Foundation and Containment	H-2-89063, Sheet 1	Structural Foundation & Grade Beam Plan
Sump Tank Containment	H-2-89065, Sheet 1	Structural Foundation, Sections & Details
Verification Tank Foundation and Containment	H-2-89068, Sheet 1	Structural Verification Tank Foundations
Load-In Station Foundation and Containment	H-2-817970, Sheet 1	Structural ETF Truck Load-in Facility Plans and Sections
Load-In Station Foundation and Containment	H-2-817970, Sheet 2	Structural ETF Truck Load-in Facility Plans and Sections

The drawings identified in Table C.5 provide an illustration of the piping and instrumentation configuration for the major process units and tanks at the 200 Area ETF, and the Load-In Station tanks. Drawings of the transfer piping systems between the LERF and 200 Area ETF, and between the Load-In Station and the 200 Area ETF also are presented in this table. These drawings are provided for general information, and to demonstrate the adequacy of the design of the tank systems.

Table C.5. Major Process Units and Tanks at Building 2025-E and Load-In Station

200 Area ETF Process Unit	Drawing Number	Drawing Title
Load-In Station	H-2-817974, Sheet 1	P&ID – ETF Truck Load-In Facility
Load-In Station	H-2-817974, Sheet 2	P&ID – ETF Truck Load-In Facility
Surge Tank	H-2-89337, Sheet 1	P&ID – Surge Tank System
UV/Oxidation	H-2-88976, Sheet 1	P&ID – UV Oxidizer Part 1
UV/Oxidation	H-2-89342, Sheet 1	P&ID – UV Oxidizer Part 2
Reverse Osmosis	H-2-88980, Sheet 1	P&ID – 1st RO Stage
Reverse Osmosis	H-2-88982, Sheet 1	P&ID – 2nd RO Stage
IX/Polishers	H-2-88983, Sheet 1	P&ID – Polisher
Verification Tanks	H-2-88985, Sheet 1	P&ID – Verification Tank System
Evaporator Vapor Body Vessel	H-2-89335, Sheet 1	P&ID – Evaporator
Thin Film Dryer	H-2-88989, Sheet 1	P&ID – Thin Film Dryer
Transfer Piping from LERF to building 2025-E	H-2-88768, Sheet 1	Piping Plan/Profile 4"– 60M-002-M17 and 3"-60M-001-M17
Transfer Piping from Load-In Station to building 2025-E	H-2-817969, Sheet 1	Civil – ETF Truck Load-In Facility Site Plan

1 **Table C.6. 200 Area Effluent Treatment Facility Tank Systems Information**

Tank Description	Material of Construction [1]	Maximum Tank Capacity[2] (gallons)	Inner (feet)	Height (feet)	Shell Thickness[3] inch
Load-In Station tanks 2025ED-59A-TK-109 2025ED-59A TK-117	304 SS	9,100	12	15.4	1/4
Load-In Station tank 2025ED-59A-TK-1	FRP	6,900	10	11.5	3/16 1/4
Surge tank 2025E-60A TK 1	304 SS	122,000	26	30	3/16
pH adjustment tank 2025E-60C-TK-1	304 SS	4,400	10	8	1/4
First RO feed tank 2025E-60F-TK-l	304 SS	5,400	10	10.5	1/4
Second RO feed tank 2025E-60F-TK-2	304 SS	2,300	10 X 5	5	3/16
Effluent pH adjustment tank 2025E-60C-TK-2	304 SS	3,800	8	12	1/4
Verification tanks 2025E-60H-TK-1A 2025E-60H-TK-1B 2025E-60H-TK-1C	Carbon steel with epoxy lining	799,000	60	37	5/16
Secondary waste receiving tanks 2025E-60I-TK-1A 2025E-60I-TK-1B	304 SS	19,500	14	18.7	1/4
Concentrate tanks 2025E-60J-TK-1A 2025E-60J-TK-1B	316L SS	6,600	10	11.5	1/4
Evaporator Vapor Body Vessel 2025E-60I EV 1	Alloy 625	5,000	8	22	
Distillate flash tank 2025E-60I-TK-2	304 SS	250	2.5	7	9/32

Tank Description	Material of Construction[1]	Maximum Tank Capacity[2] (gallons)	Inner (feet)	Height (feet)	Shell Thickness[3] inch
Sump Tank 1 2025E-20B-TK-l	304 SS	1,800	5 X 5	11	3/16
Sump Tank 2 2025E-20B-TK-2	304 SS	1,800	5 X 5	11	3/16

[1]Type 304 SS, 304L, 316 SS and alloy 625 provide corrosion protection.
[2]The structural design capacity is based on the tank dimensions (reference CHPRC-01900)
[3]The nominal thickness of 200 Area ETF tanks is represented.
304 SS = stainless steel type 304 or 304L.
316L SS = stainless steel type 316L
FRP = Fiberglass-reinforced plastic.

Table C.7. 200 Area Effluent Treatment Facility Additional Tank System Information

Tank Description	Liner Materials	Pressure Controls	Foundation Materials	Structural Support	Seams	Connections
Load-In Station tanks 2025ED-59A-TK-109 2025ED-59A-TK-117	None	vent to atmosphere	concrete slab	SS skirt bolted to concrete	welded	flanged
Load-In Station tank 2025ED-59A-TK-1	None	vent to atmosphere	concrete slab	bolted to concrete	none	flanged
Surge tank 2025E-60A-TK-1	None	vacuum breaker valve/vent to VOG	reinforced concrete ring plus concrete slab	structural steel on concrete base	welded	flanged
pH adjustment tank 2025E-60C-TK-1	None	vent to VOG	concrete slab	carbon steel skirt	welded	flanged
First RO feed tank 2025E-60F-TK-l	None	vent to VOG	concrete slab	carbon steel skirt	welded	flanged
Second RO feed tank 2025E-60F-TK-2	None	vent to VOG	concrete slab	carbon steel frame	welded	flanged
Effluent pH adjustment tank	None	vent to VOG	concrete slab	carbon steel skirt	welded	flanged

Tank Description	Liner Materials	Pressure Controls	Foundation Materials	Structural Support	Seams	Connections
2025E-60C-TK-2						
Verification tanks 2025E-60H-TK-lA 2025E-60H-TK-1B 2025E-60H-TK-1C	Epoxy	filtered vent to atmosphere	reinforced concrete ring plus concrete slab	structural steel on concrete base	welded	flanged
Secondary waste receiving tanks 2025E-60I-TK-1A 2025E-60I-TK-1B	None	vent to VOG	concrete slab	carbon steel skirt	welded	flanged
Concentrate tanks 2025E-60J-TK-1A 2025E-60J-TK-1B	None	vent to VOG	concrete slab	carbon steel skirt	welded	flanged
Evaporator Vapor Body Vessel (2025E 60I EV 1)	None	pressure indicator/pressure relief valve vapor vent to DFT/VOG	concrete slab	carbon steel frame	welded	flanged
Distillate flash tank 2025E-60I-TK-2	None	Pressure relief valve/vent to vent gas cooler/VOG	concrete slab	carbon steel I-beam and cradle	welded	flanged
Sump Tank 1 2025E-20B-TK-l	None	vent to VOG	concrete containment	reinforced concrete containment basin	welded	flanged
Sump Tank 2 2025E-20B-TK-2	None	vent to VOG	concrete containment	reinforced concrete containment basin	welded	flanged

DFT = distillate flash tank

VOG = vessel off gas system

Table C.8. Ancillary Equipment and Material Data

System	Ancillary Equipment	Number	Material
Load-In Station tanks	Load-In Station/transfer pumps (2)	2025ED-P-103A/-103B	316 SS
		2025ED-P-001A/-001B	Cast iron
	Load-In Station filters (6)	59A-FL-001/-002/-003/ -004/-005/-006	304 SS
Surge tank	Surge tank pumps (3)	2025E-60A-P-1A/-1B/-1C	304 SS
Rough filter	Rough filter	2025E-60B-FL-1	304 SS
UV/OX	UV oxidation inlet cooler	2025E-60B-E-1	316 SS
	UV oxidizers (4)	2025E-60D-UV-1A/-1B/-2A/-2B	316 SS
pH adjustment	pH adjustment pumps (2)	2025E-60C-P-1A/-1B	304 SS
Peroxide decomposer	H2O2 decomposers (2)	2025E-60D-CO-1A/-1B	CS with epoxy coating
Fine filter	Fine filter	2025E-60B-FL-2	304 SS
Degasification	Degasification column inlet cooler	2025E-60E-E-1	316 SS
	Degasification column	2025E-60E-CO-1	FRP
	Degasification pumps (2)	2025E-60E-P-1A/-1B	316 SS
RO	Feed/booster pumps (6)	2025E-60F-P-1A/-1B/-2A/-2B/-3A/-3B	304 SS
	Reverse osmosis arrays (21)	2025E-60F-RO-01 through -21	Membranes: polyamide Outer piping: 304 SS
IX/Polishers	Polishers (3)	2025E-60G-IX-1A/-1B-1C	CS with epoxy coating
	Resins strainers (3)	2025E-60G-S-1A/-1B/-1C	304 SS
Effluent pH adjustment	Recirculation/transfer pumps (2)	2025E-60C-P-2A/-2B	304 SS/PVC
Verification tanks	Return pump	2025E-60H-P-1	304 SS
	Transfer pumps (2)	2025E-60H-P-2A/-2B	
Secondary waste receiving tanks	Secondary waste feed pumps (2)	2025E-60I-P-1A/-1B	304 SS
Evaporator Vapor Body Vessel system	Feed/distillate heat exchanger	2025E-60I-E-02	Tubes: 316 SS Shell: 304 SS
	Heater (reboiler)	2025E-60I-E-01	Tubes: alloy 625 Shell: 304 SS
	Recirculation pump	2025E-60I-P-02	316 SS
	Concentrate transfer pump	2025E-60I-P-04	316 SS
	Entrainment separator	2025E-60I-DE-01	Top section: 316 SS Bottom section: alloy 625

System	Ancillary Equipment	Number	Material
	Vapor compressor (incl. silencers)	2025E-60I-C-01	304 SS
	Silencer drain pump	2025E-60I-P-06	316 SS
	Level control tank	2025E-60I-TK-5	304 SS
	Distillate flash tank pump	2025E-60I-P-03	316 SS
Concentrate tanks	Concentrate circulation pumps (2)	2025E-60J-P-1A/-1B	316 SS
Thin film dryer	Concentrate feed pump	2025E-60J-P-2	316 SS
	Thin film dryer	2025E-60J-D-1	Interior surfaces: alloy 625 Rotor and blades: 316 SS
	Powder hopper	2025E-60J-H-1	316 SS
	Spray condenser	2025E-60J-DE-01	316 SS
	Distillate condenser	2025E-60J-CND-01	Tubes: 304 SS Shell: CS
	Dryer distillate pump	2025E-60J-P-3	316 SS
Resin dewatering	Dewatering pump	2025E-80E-P-1	

Table C.9. Concrete and Masonry Coatings

Location	Product Name	Applied Film Thickness, Estimated
		Mils
2025-E Process Area, Truck Bay, and Container Storage Area		
Floor: Topcoat	Chemproof PermaCoat 4000[1]	2 coats at 12-16 mils
Walls to 7 feet, Doors & Jambs	Chemproof PermaCoat 4000 Vertical[1]	2 coats at 12-16 mils
2025-ED Load-In Station Tank Pit		
Floor and Walls Topcoat	Elasti Liner I/II[2,3]	80 mils
Floor and Walls: Primer	Techni-Plus E[2]	5.0-7.0 mils
Surge Tank and Verification Tank Berms		
Floors (and Walls at Surge Tank): Topcoat	Elasti-Liner I[2]	80 mils
Floors (and Walls at Surge Tank): Primer	Techni-Plus E3[2]	5.0-7.0 mils

[1]PermaCoat is a trademark of Chemproof Polymers, Inc.

[2]Elasti-Liner and Techni-Plus are trademarks of KCC Corrosion Control, Inc.

[3]Elasti-Liner I or a combination of Elasti-liner I and Elasti-liner II

Table C.10. Geomembrane Material Specifications

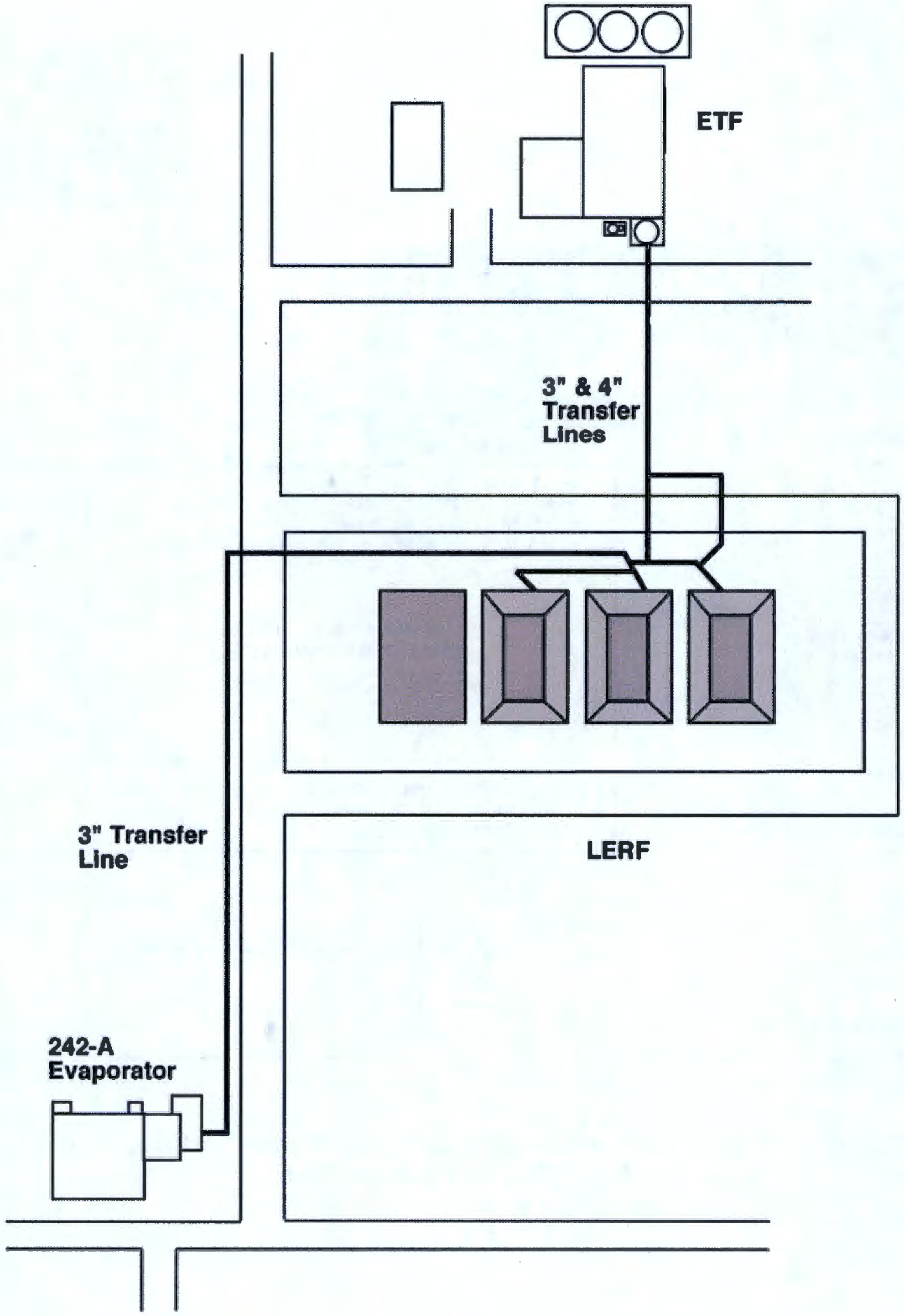
Property	Value
Specific gravity	0.932 to 0.950
Melt flow index	0.04 ounce/10 minute, maximum
Thickness (thickness of flow marks shall not exceed 200 percent of the nominal liner thickness)	1.5 millimeter 0.06 inches ± 10%
Carbon black content	1.8 to 3%, bottom liner 2 to 3% top liner
Tensile properties (each direction)	
Tensile strength at yield	120 pounds/inch width, minimum
Tensile strength at break	180 pounds/inch width, minimum
Elongation at yield	10%, minimum
Elongation at break	500%, minimum
Tear resistance	30 pounds, minimum
Puncture resistance	69 pounds, minimum
Low temperature/brittleness	-688°F, maximum
Dimensional percent change each direction)	±2%, maximum
Environmental stress crack	750 hour, minimum
Water absorption	0.1% maximum and weight change
Hydrostatic resistance	450 pounds/inch^2
Oxidation induction time (200 C/l atm. $O_{2)}$	90 minutes

Reference: *Construction Specifications for 242-A Evaporator and PUREX Interim Retention Basins* (W 105, KEH 1990). Format uses NSF 54 table for high-density polyethylene as a guide (NSF 1985). However, RCRA values for dimensional stability and environmental stress crack have been added.

Table C.11. Drainage Gravel Specifications

Property	Value
Sieve Size	
1 inch	100 wt.% passing
0.75 inches	80 – 100 wt.% passing
0.375 inches	10 – 40 wt.% passing
0.187 inches	0 – 4 wt.% passing
Permeability	0.04 inches/second, minimum

Reference: Sieve size is from WSDOT M41-10-88, Section 9.03.1(3)C for Grading No. 5 (WSDOT 1988). Permeability requirement is from WAC 173-303-650(2)(j) for new surface impoundments.



ETF = Effluent Treatment Facility
LERF = Liquid Effluent Retention Facility

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Figure C.1. Liquid Effluent Retention Facility Layout

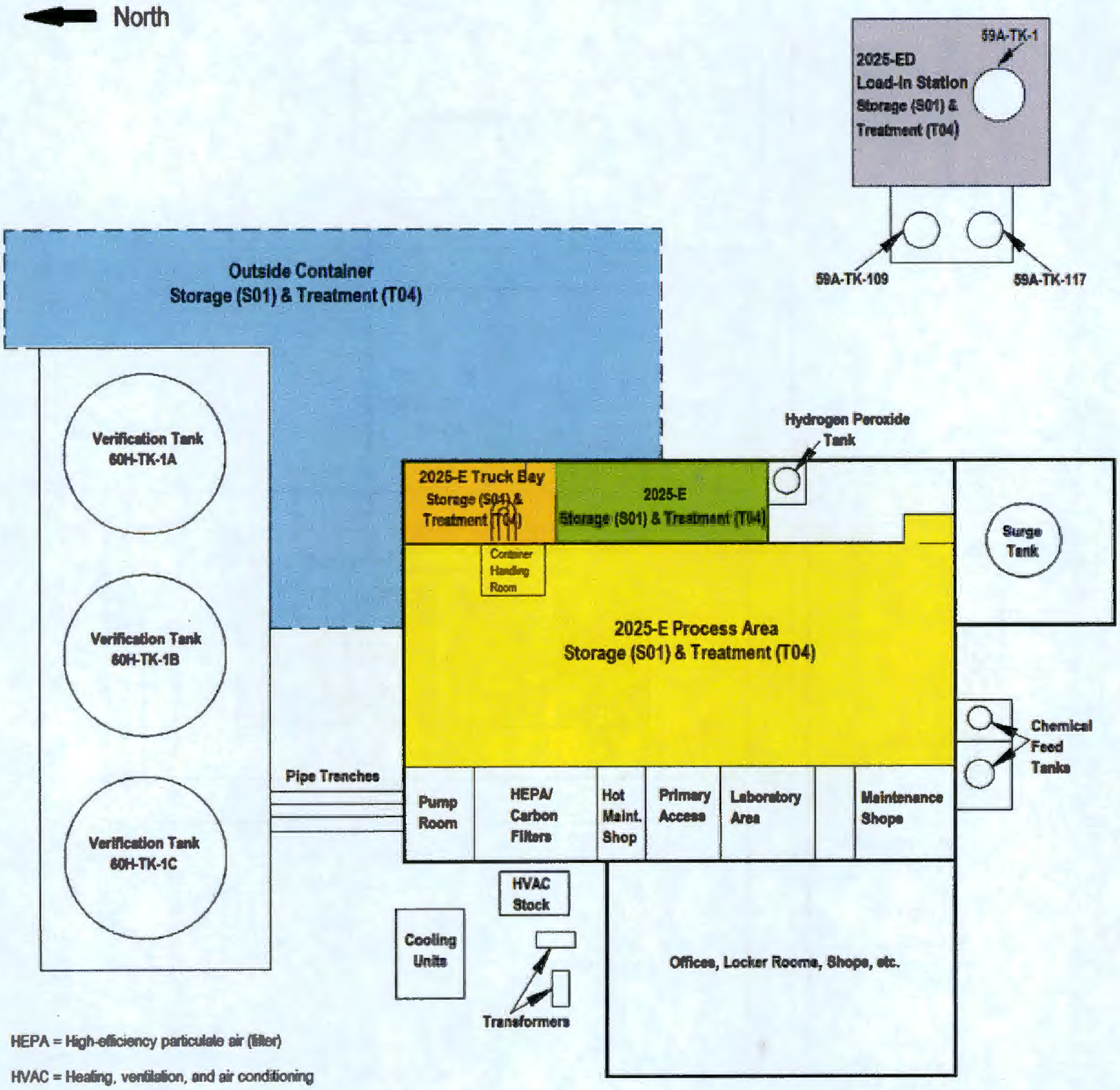
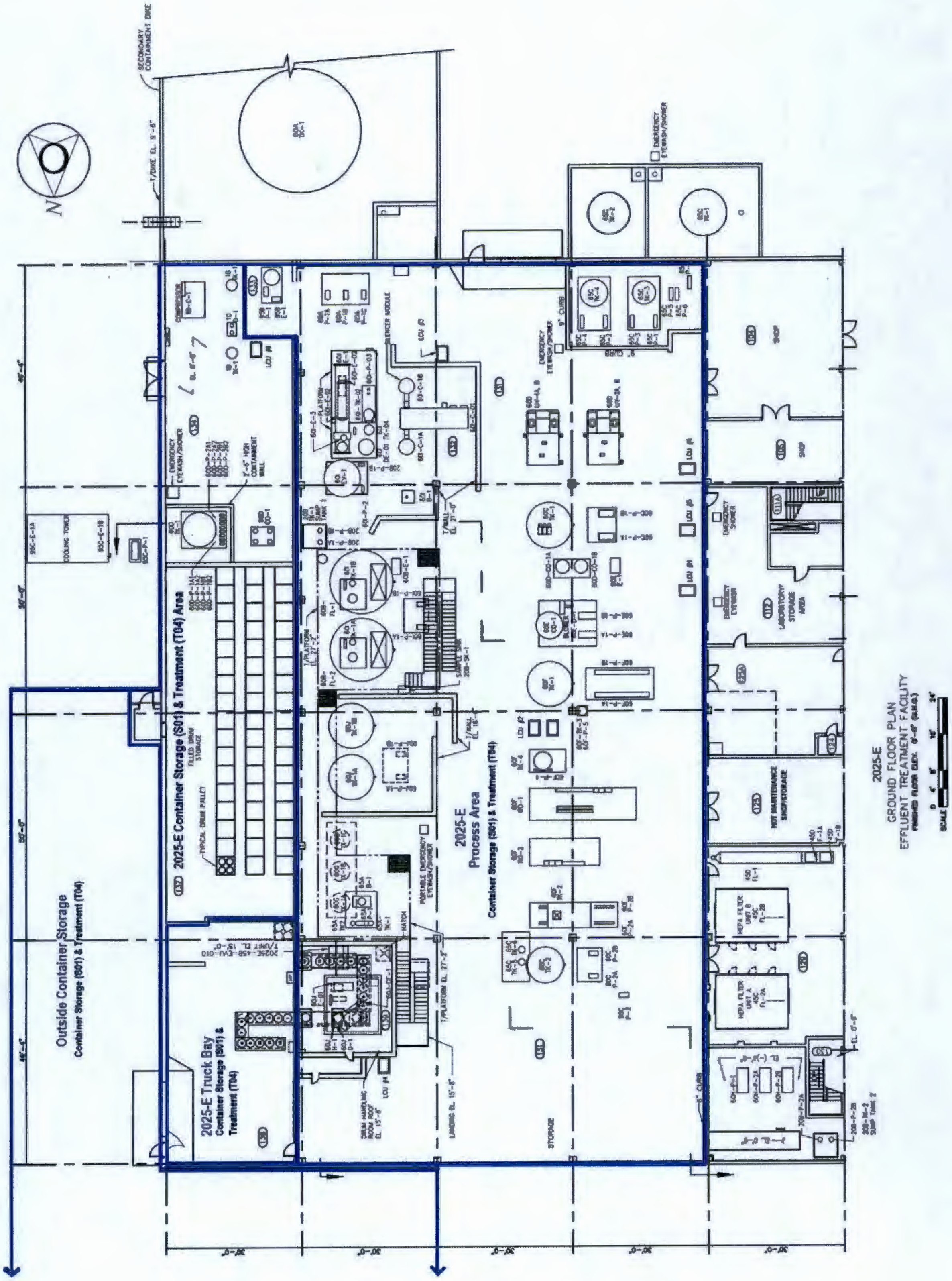
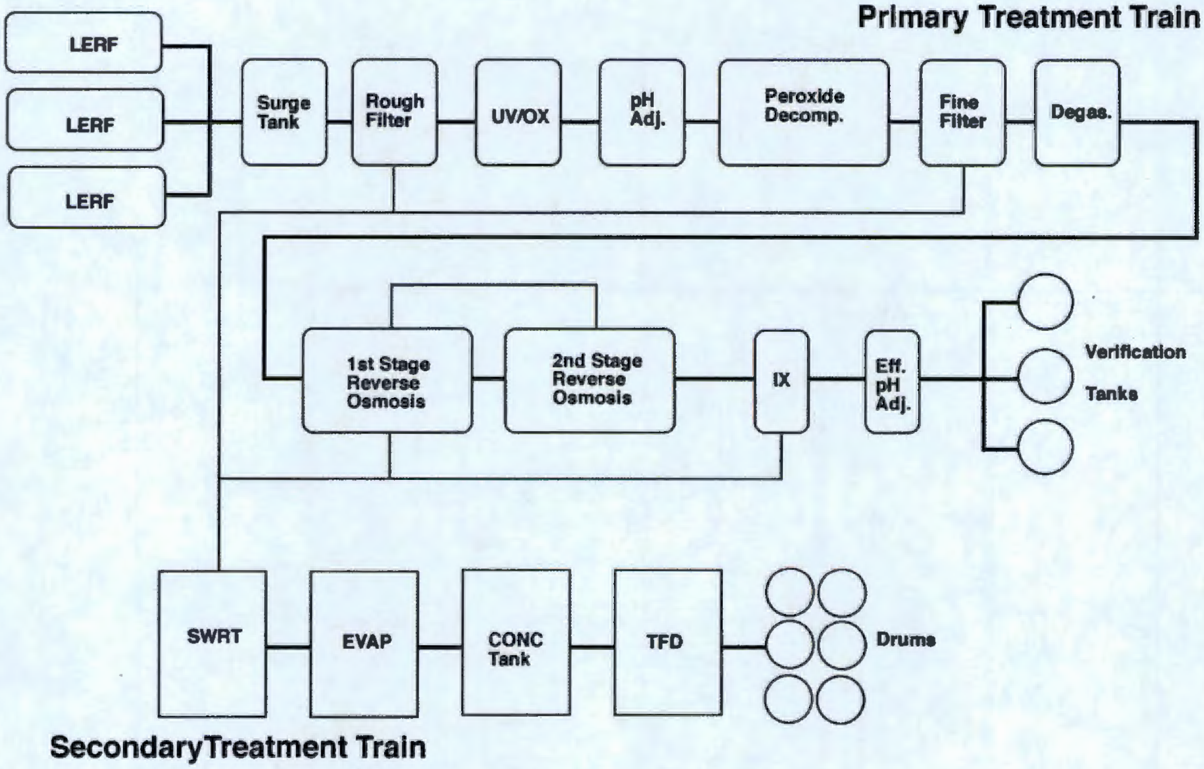


Figure C.2. Plan View of the Five Permitted Container Storage and Treatment Areas at 200 Area Effluent Treatment Facility



1 **Figure C.3. Building 2025-E Ground Floor Plan**



CONC Tank = Concentrate tank
Degas. = Degasification column
Eff. pH Adj. = Effluent pH adjustment tank
EVAP = Evaporator
IX = Ion Exchange
LERF = Liquid Effluent Retention Facility
pH Adj. = pH adjustment tank
SWRT = Secondary waste receiving tank
TFD = Thin film dryer
UV/OX = Ultraviolet Oxidation

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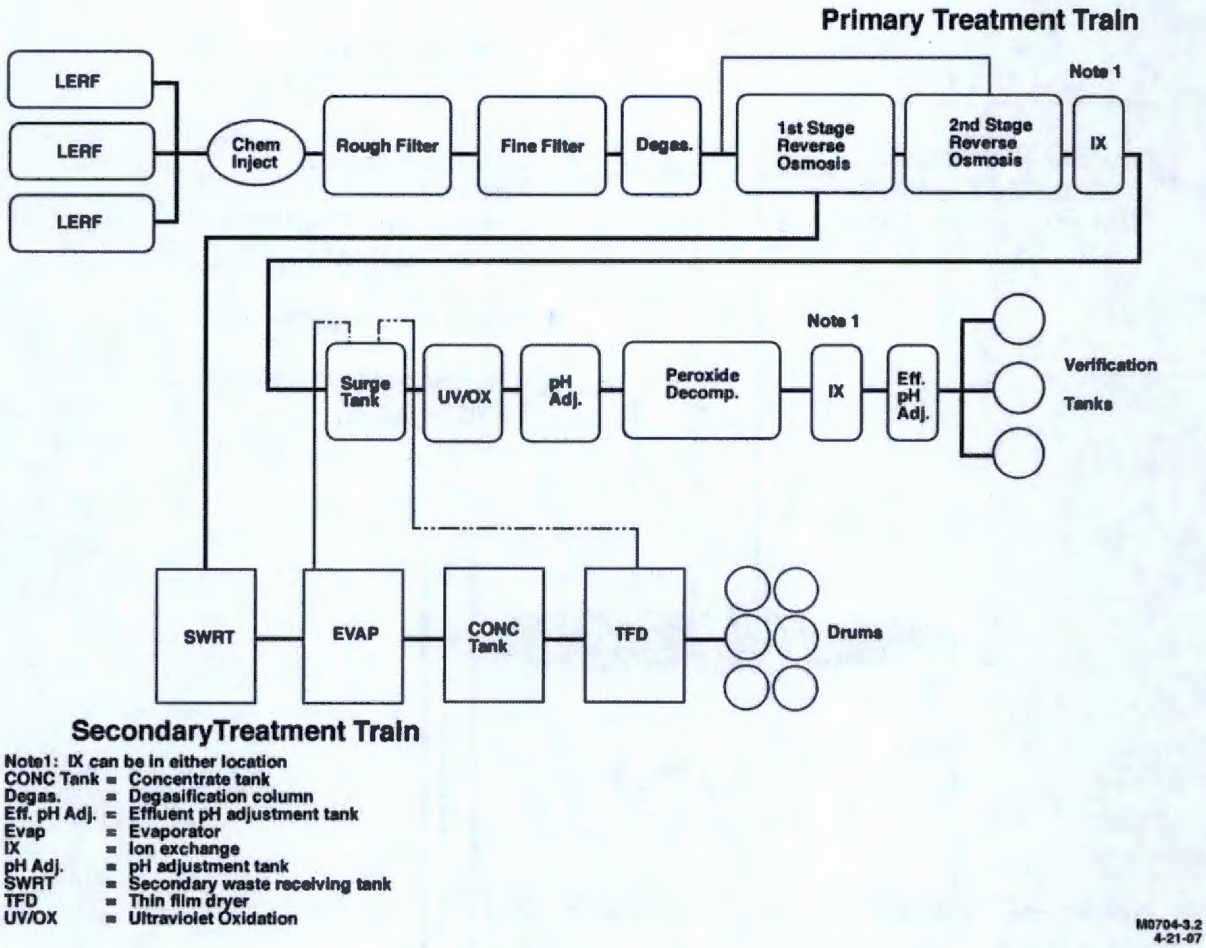
Figure C.4. Example - 200 Area Effluent Treatment Facility Configuration 1



1 **Figure C.5. Example - 200 Area Effluent Treatment Facility Configuration 2**

2

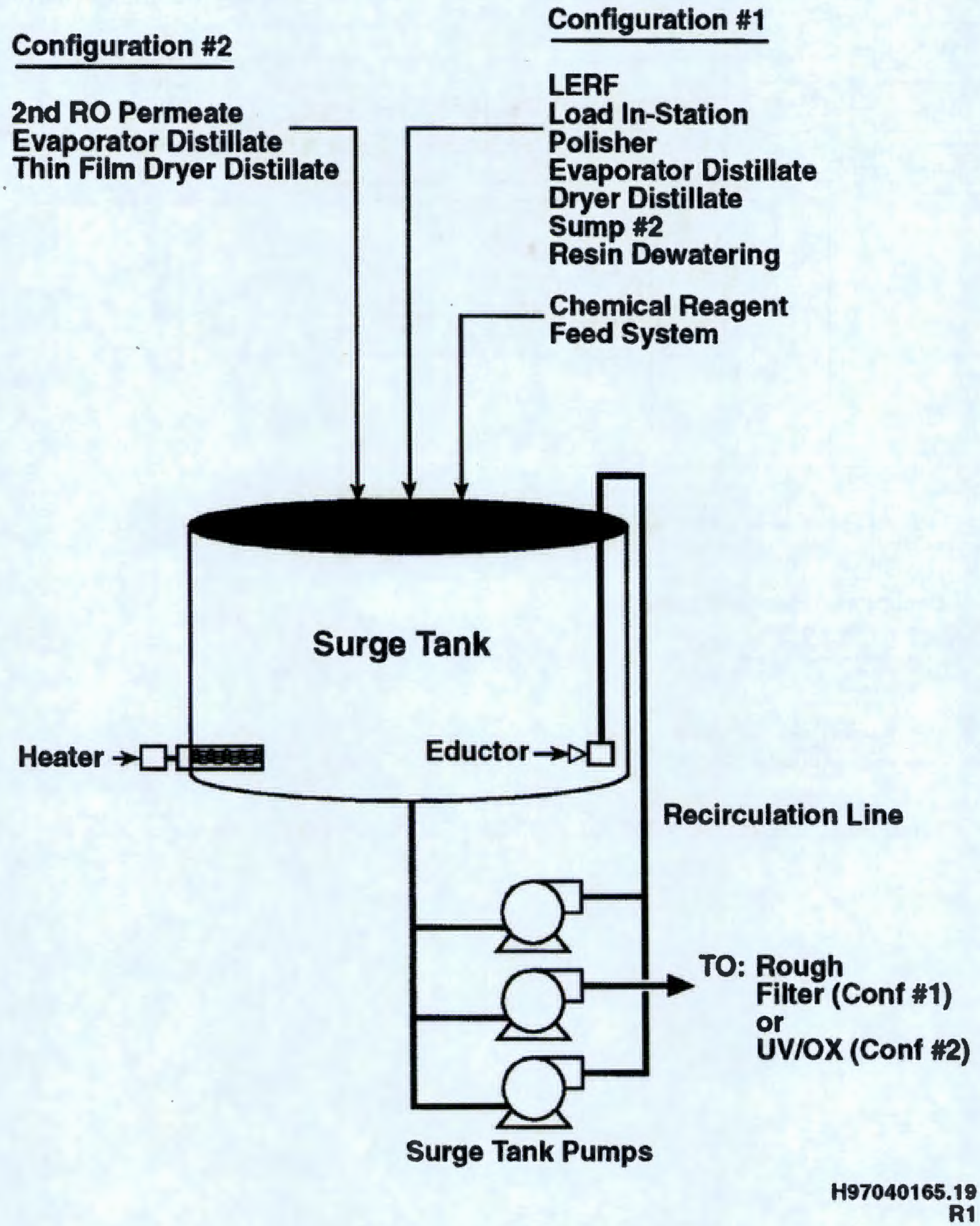
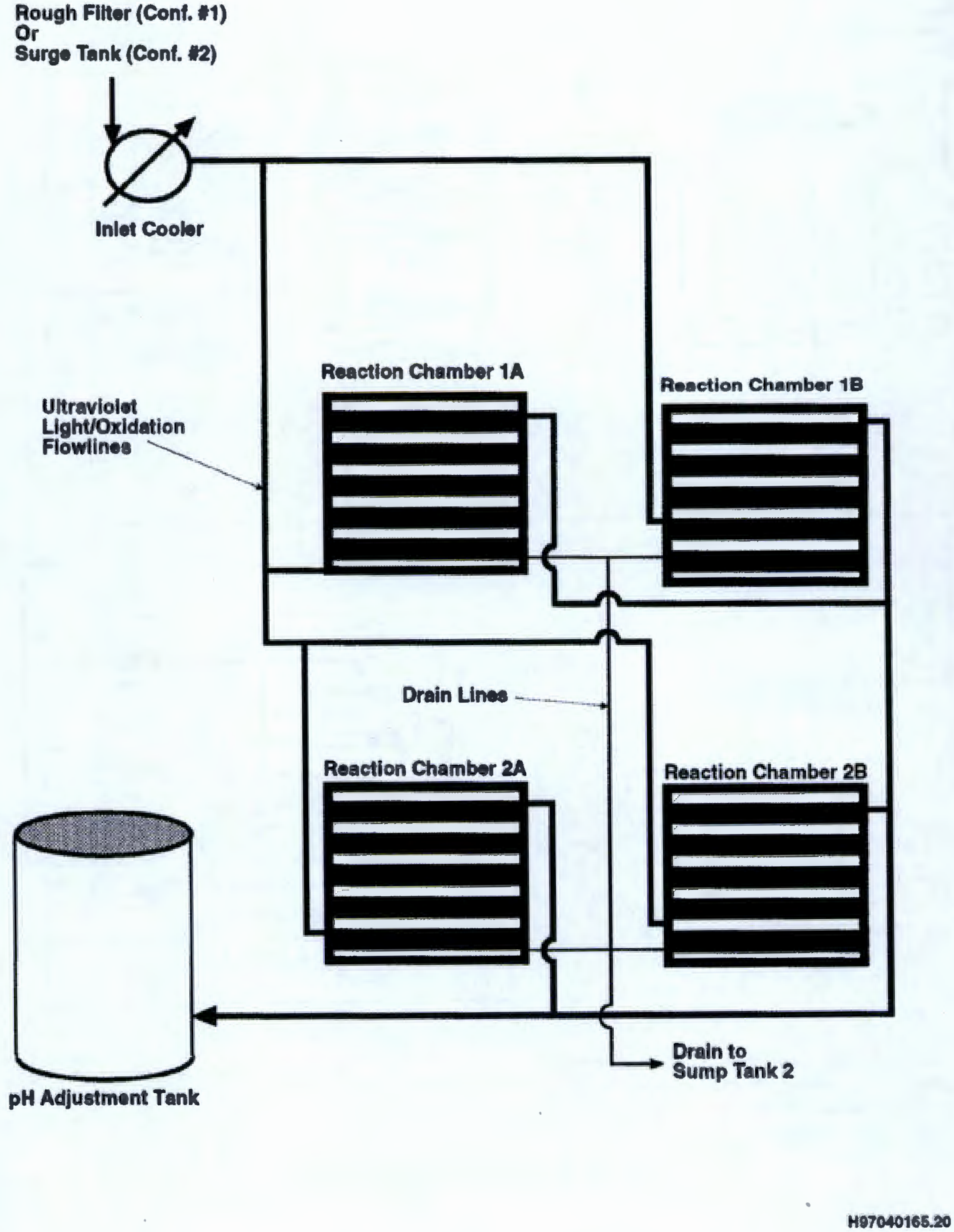
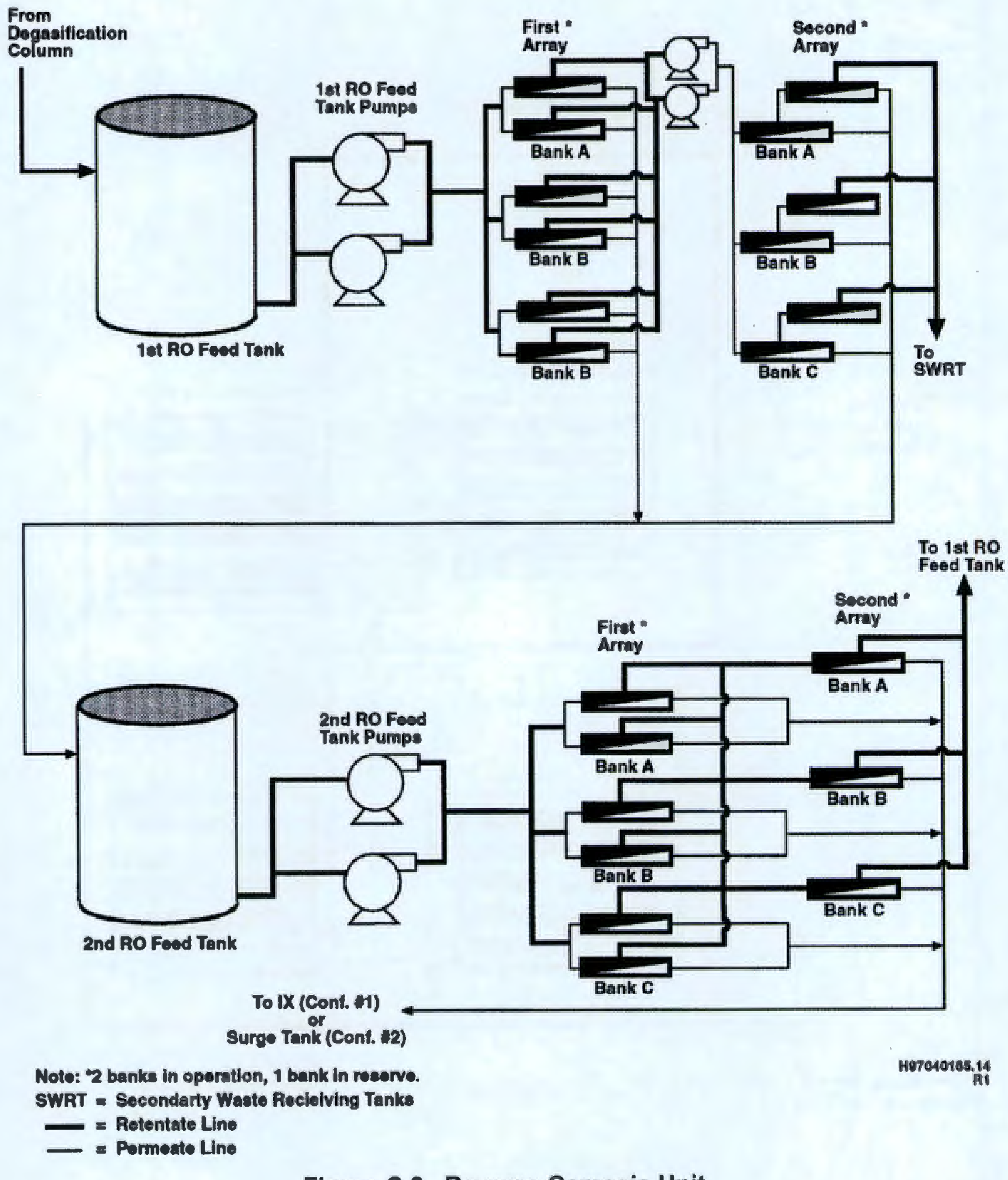


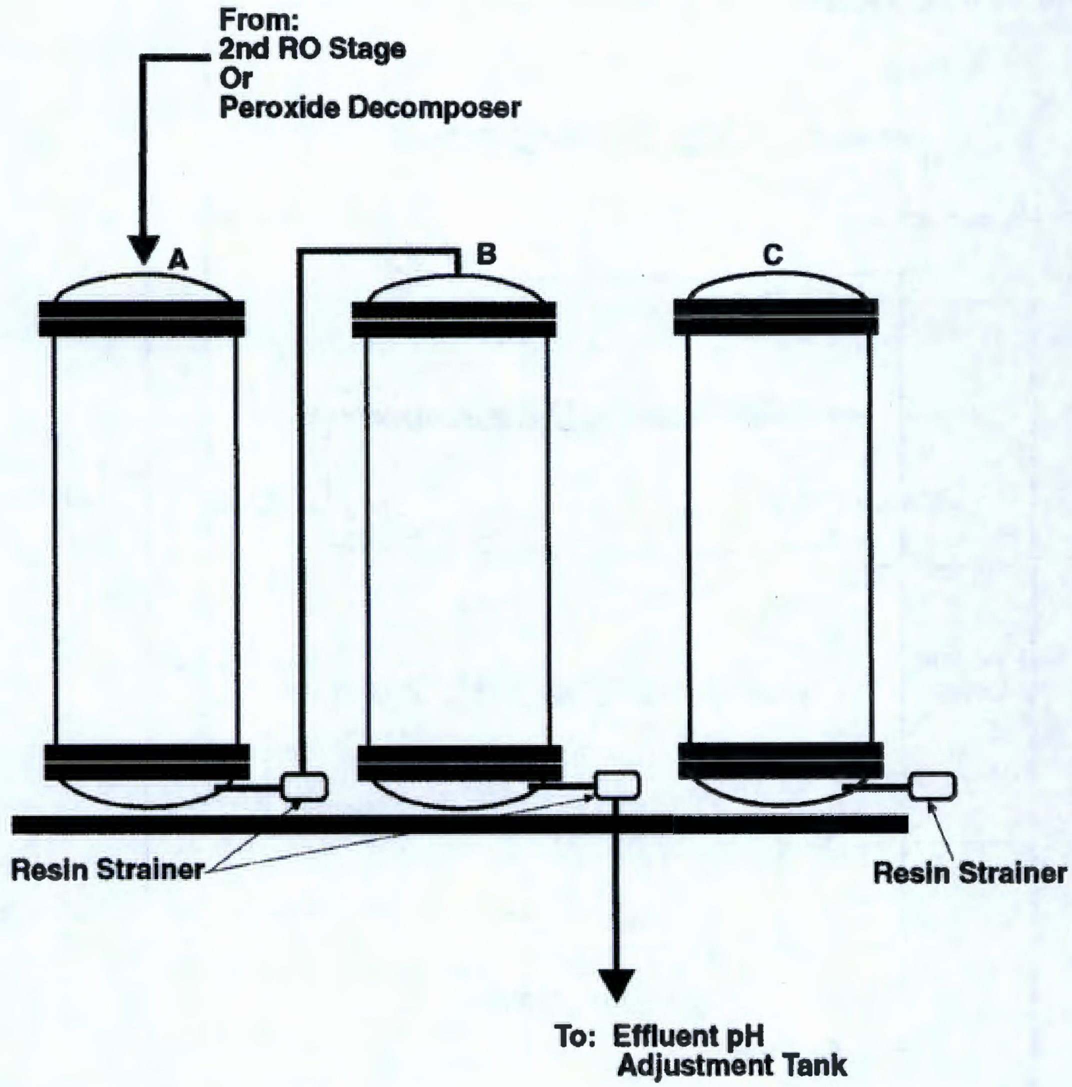
Figure C.6. Surge Tank



1 **Figure C.7. Ultraviolet Light/Oxidation Unit**



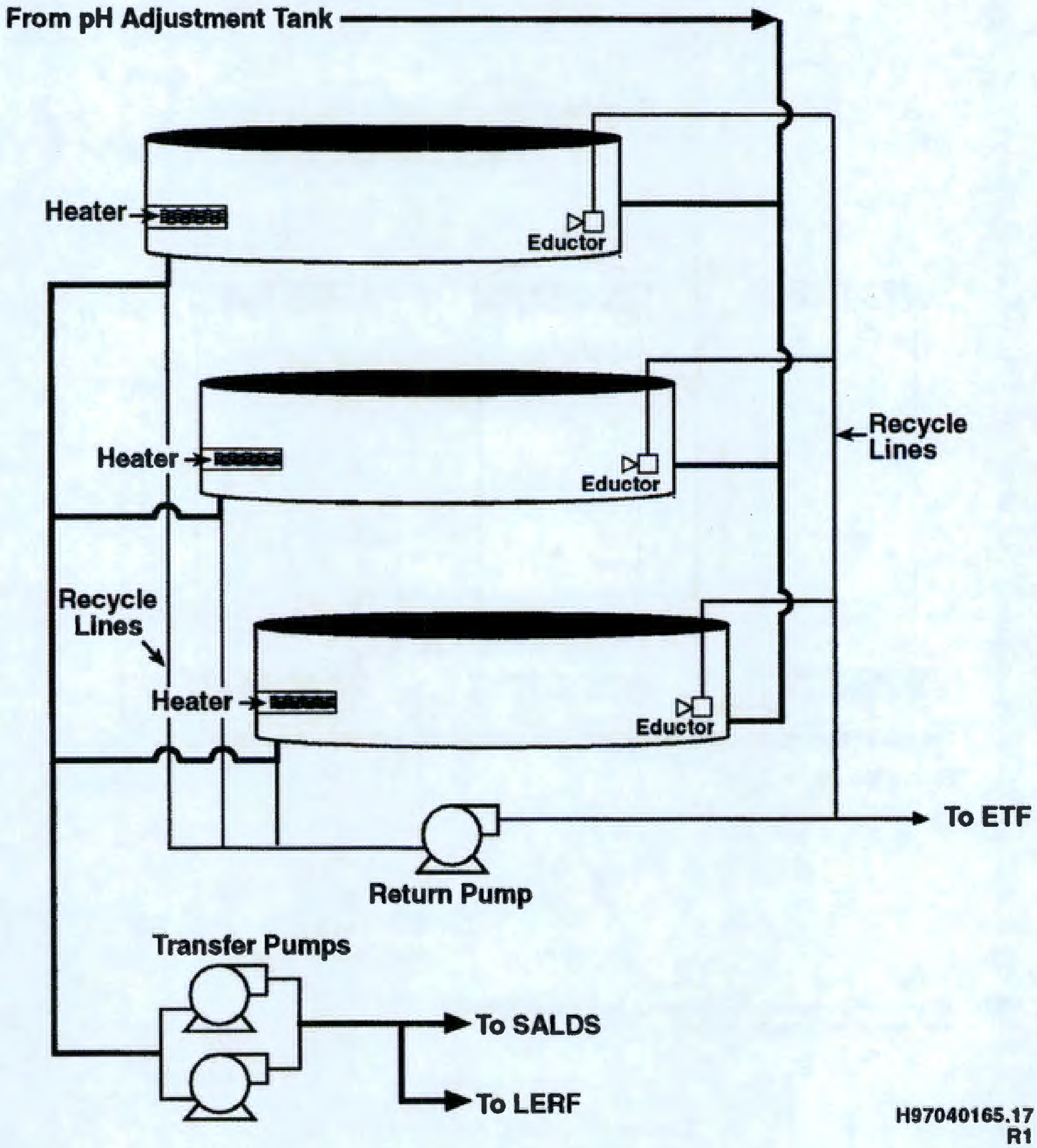
1 **Figure C.8. Reverse Osmosis Unit**



**NOTE: Example Configuration- Column A and B In Operation,
Column C In Standby Mode**

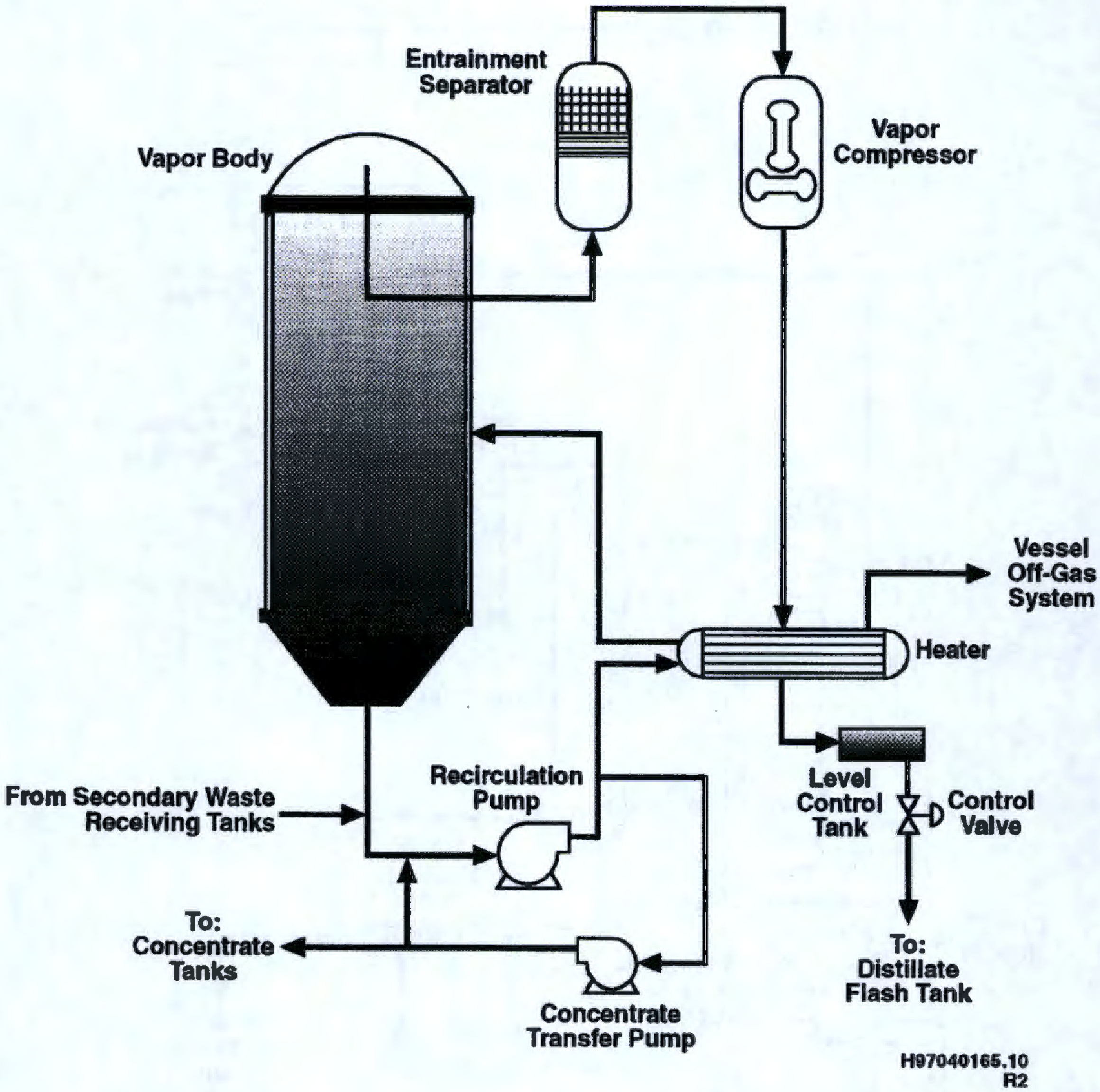
H97040165.18

Figure C.9. Ion Exchange Unit



1 Figure C.10. Verification Tanks

2



1 **Figure C.11. 200 Area Effluent Treatment Facility Evaporator**

2

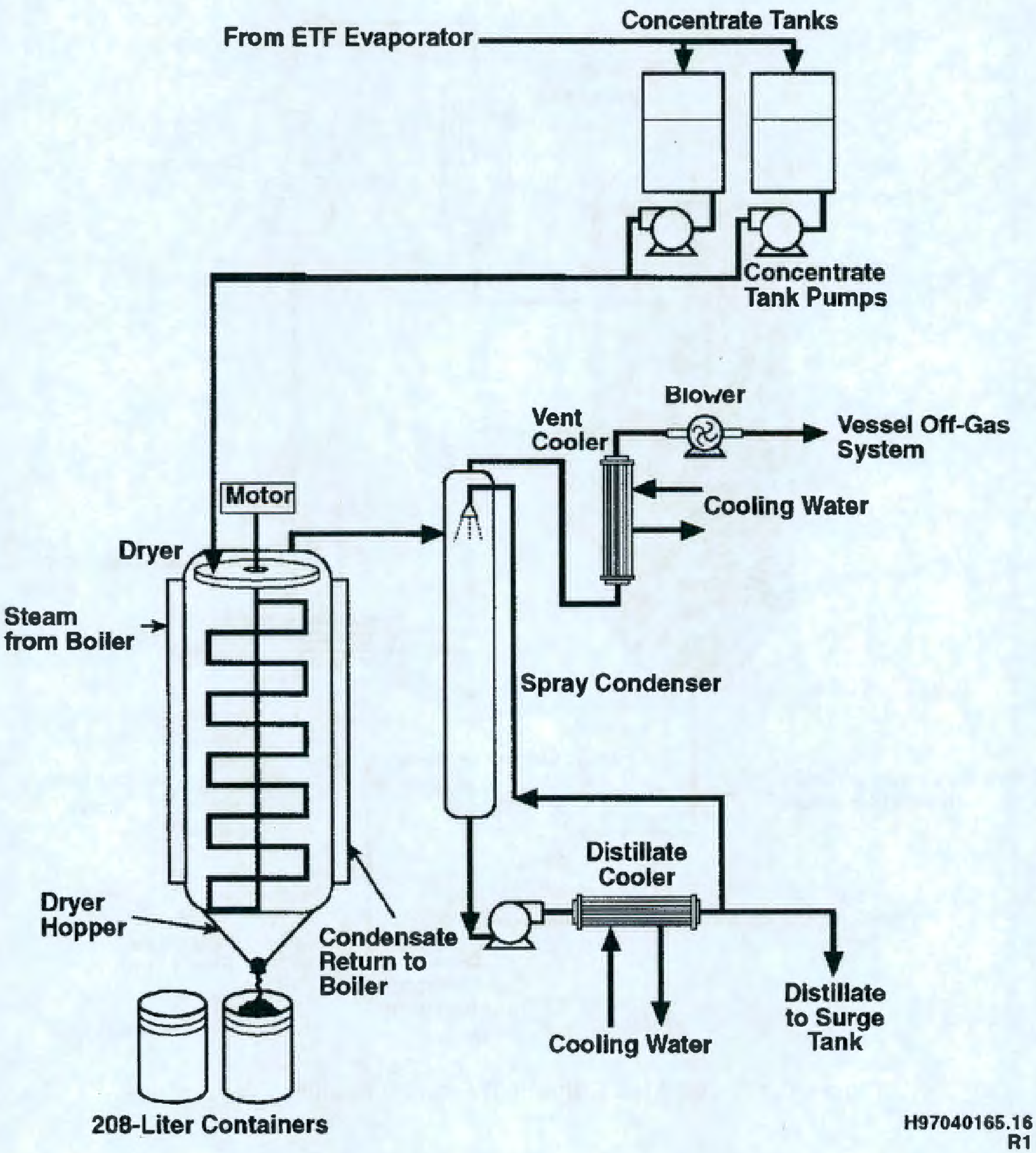


Figure C.12. Thin Film Dryer

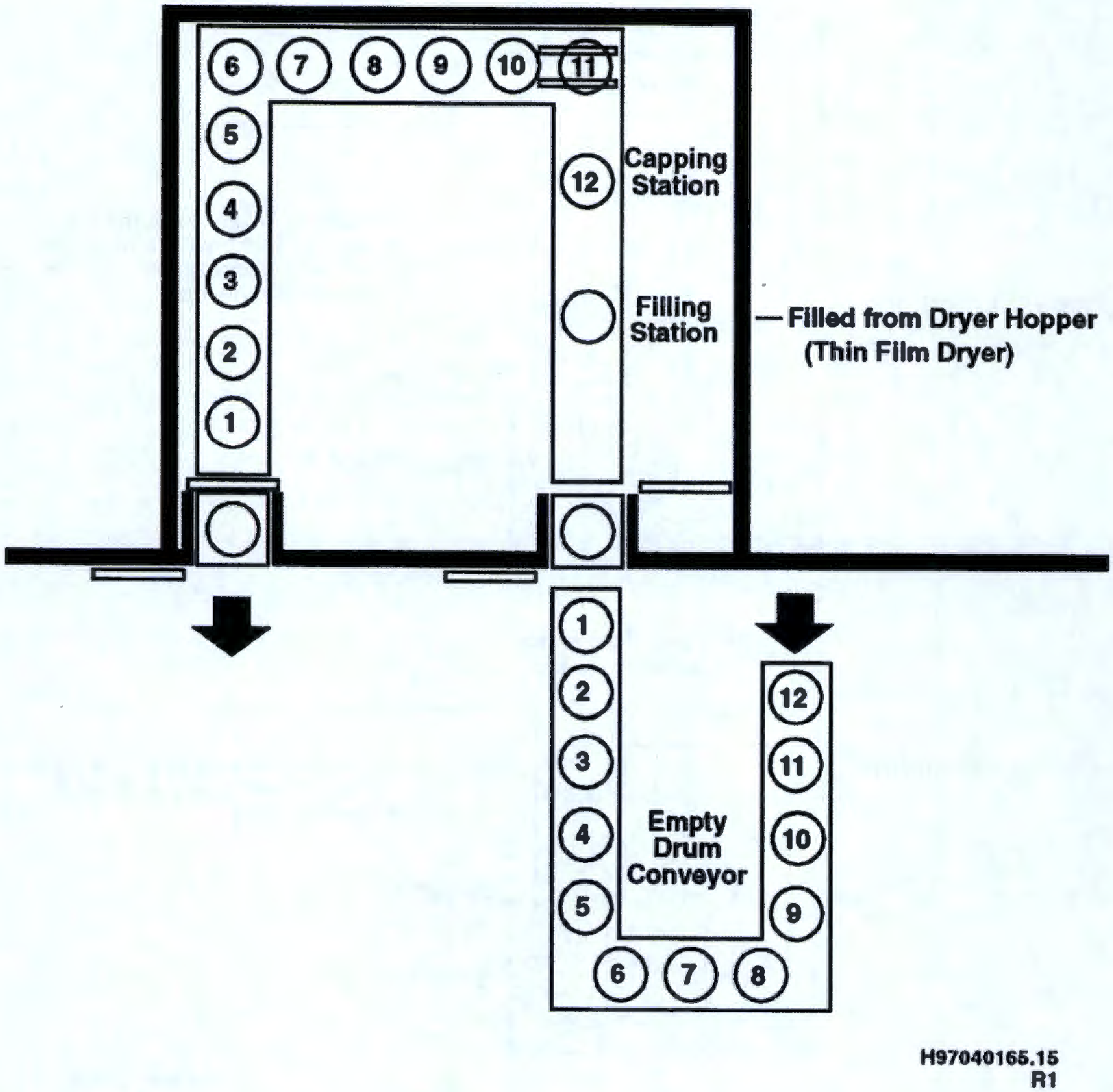


Figure C.13. Container Handling System

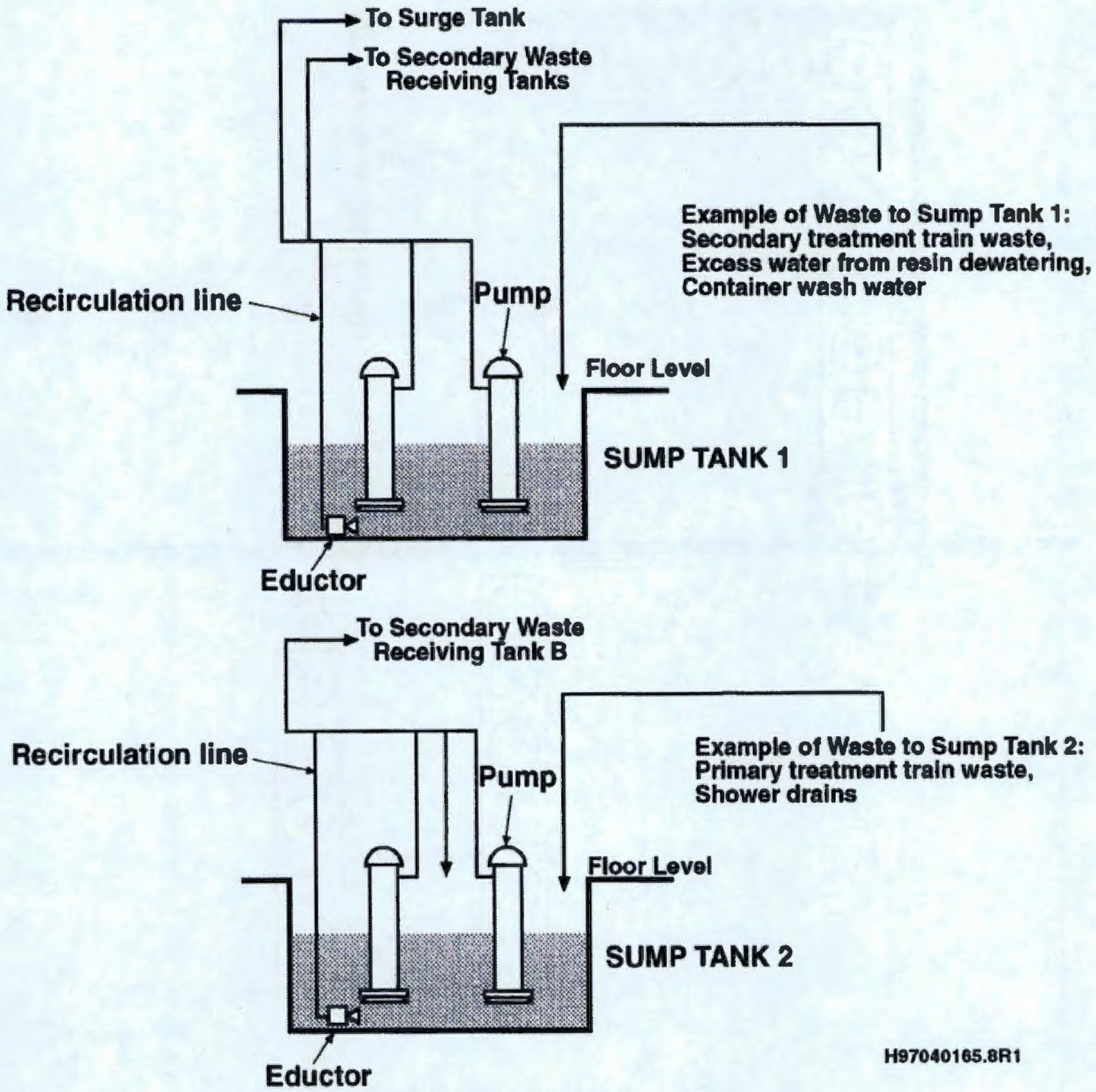


Figure C.14. 200 Area Effluent Treatment Facility Sump Tanks

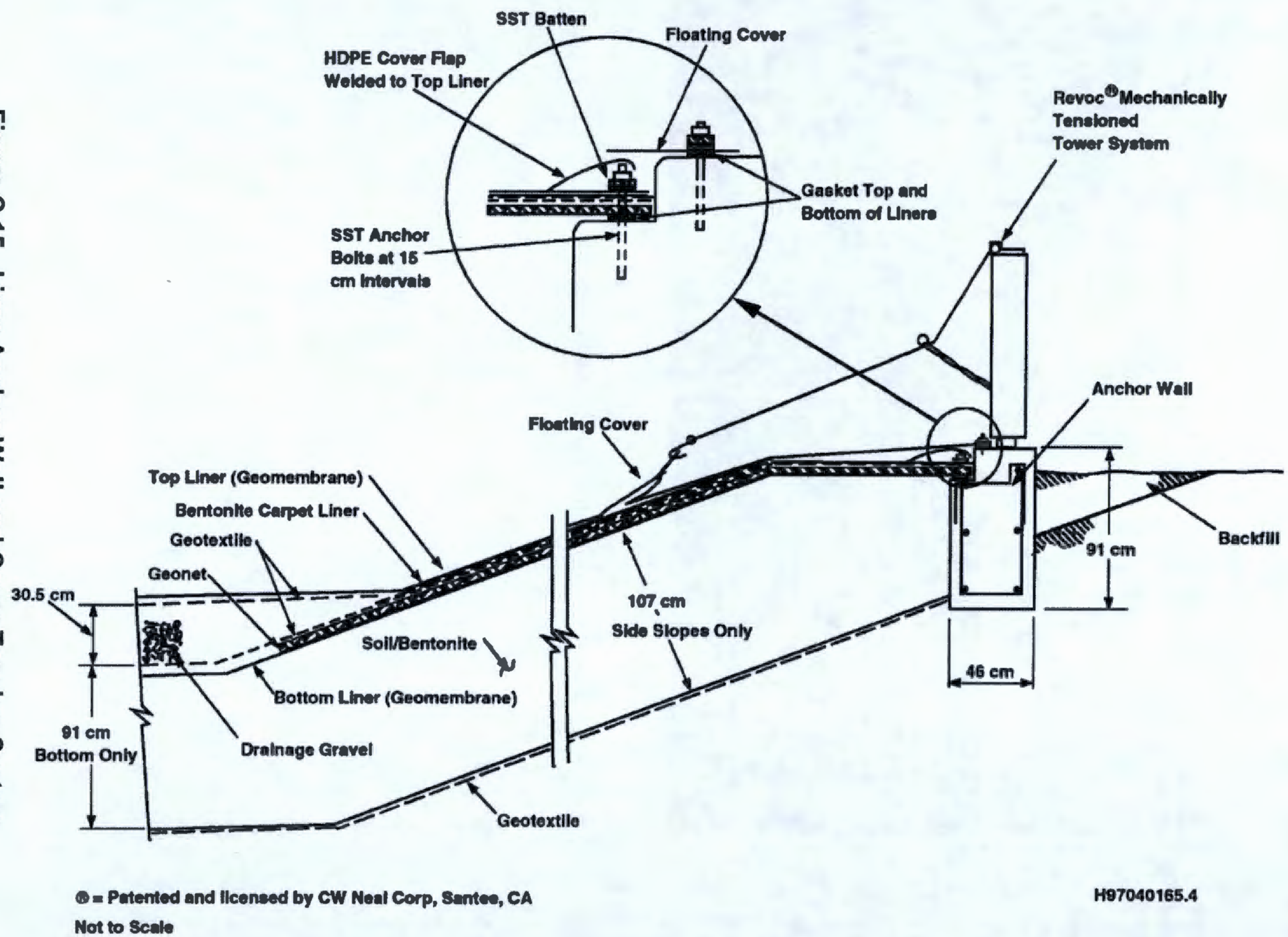
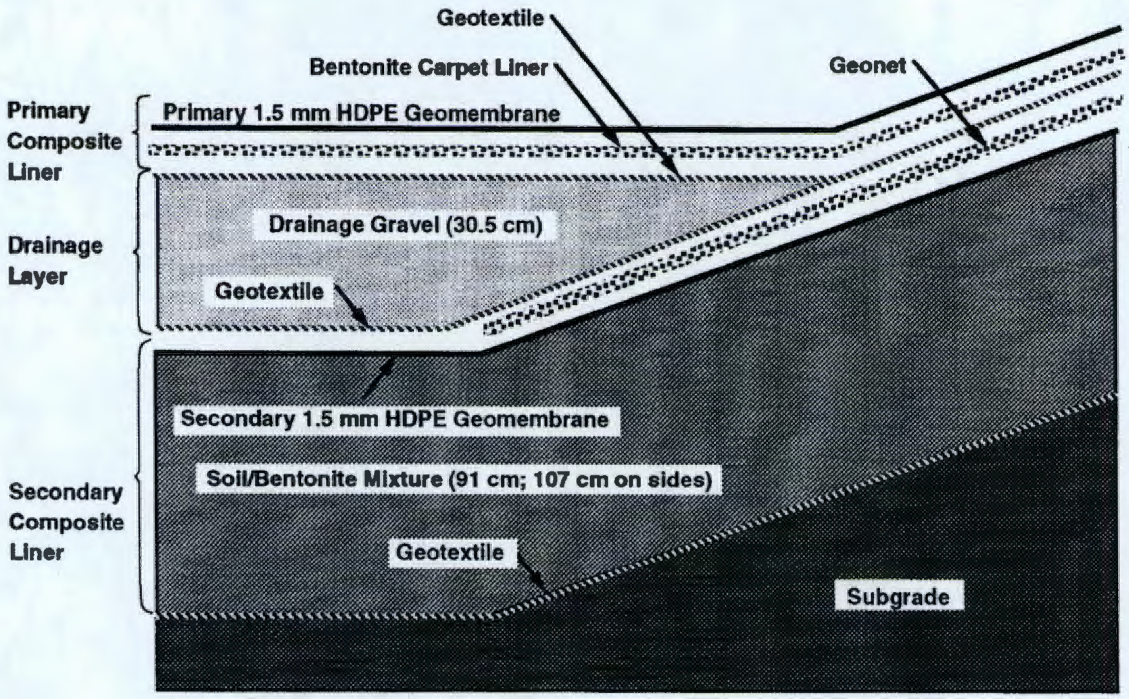


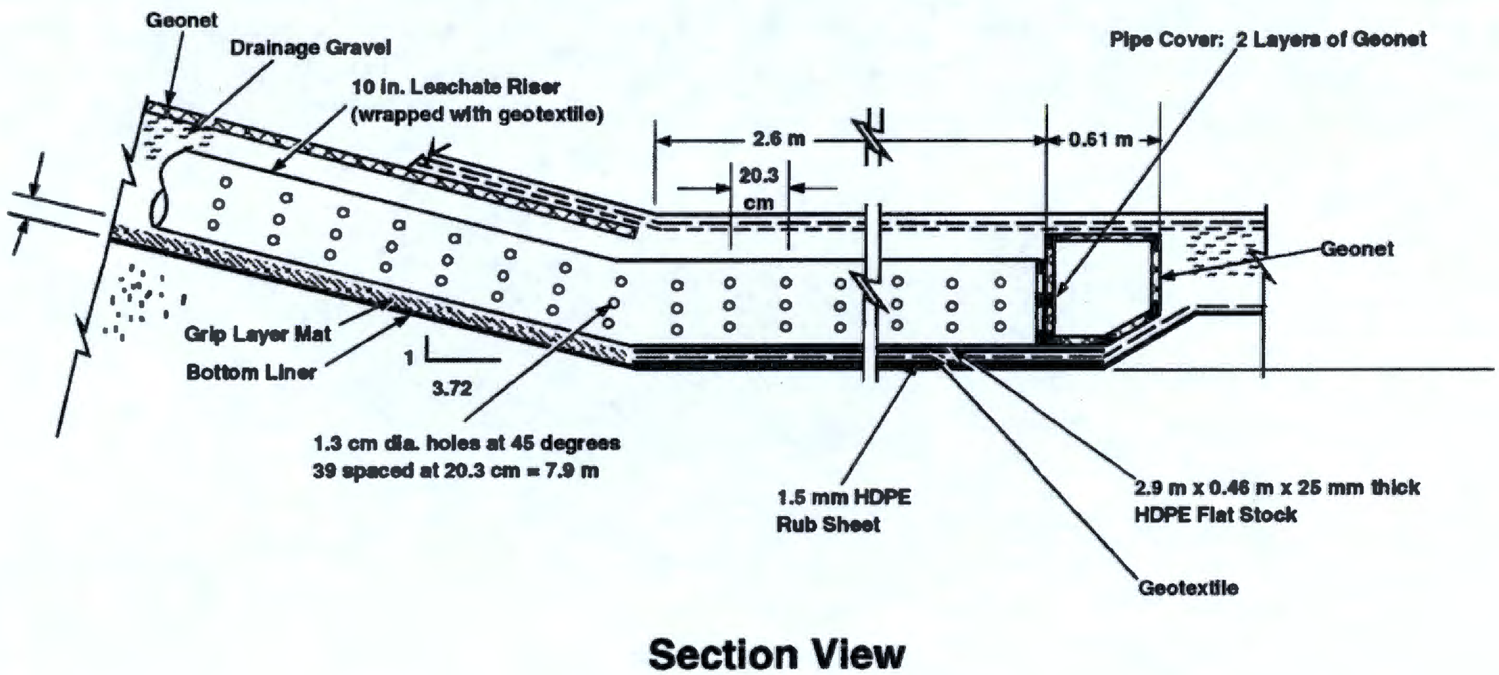
Figure C.15. Liner Anchor Wall and Cover Tension System



Not to Scale

H97040165.1

Figure C.16. Liner System Schematic



HDPE: High Density Polyethylene

Not to Scale

H97040165.3

Figure C.17. Detail of Leachate Collection Sump

LIQUID EFFLUENT RETENTION FACILITY & 200 AREA EFFLUENT TREATMENT FACILITY ADDENDUM D

GROUNDWATER MONITIORING PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/25/2017	8C.2017.3F

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ADDENDUM D
GROUNDWATER MONITORING PLANS

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EXECUTIVE SUMMARY

This document presents a revision to the DOE/RL-2013-46, Rev. 0, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility*.[1] This revised monitoring plan is driven by the addition of well 299-E26-15 and compliance with WA7890008967[2] (hereinafter referred to as the Hanford Facility *Resource Conservation and Recovery Act of 1976* [3] [RCRA] Permit), Part III Operating Units–Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF) Operating Unit Group (OUG)-3, permit condition III.3.R.3.b, submittal of a Class 2 Permit modification (WAC 173-303-830,[4] Appendix I, C.1.a) to update Addendum D of the RCRA Permit, "Groundwater Monitoring Plan," including the addition of well 299-E26-15 into the network and removal of crossgradient well 299-E26-77 from the network. Part of the update is attributed to the inventory screening documented in SGW-41072, Rev. 1[5], with resulting changes to the constituent list, statistical method, and frequency of monitoring. The U.S. Department of Energy (DOE) Richland Operations Office is revising this groundwater monitoring plan to incorporate the most current Hanford Site groundwater monitoring information for the LERF treatment, storage, and disposal unit. This document revision will supersede the previous version (DOE/RL-2013-46, Rev. 0) upon modification of the Hanford Facility RCRA Permit. This detection groundwater monitoring plan is the principal controlling document for conducting groundwater monitoring at LERF.

LERF is in final status OUG-3, located adjacent the northeast corner of the 200 East Area, and is under a detection groundwater monitoring program. LERF and the 200 Area ETF work together as an aqueous waste treatment system that provides storage and treatment for a variety of aqueous mixed waste. Each of the three LERF basins have an operating capacity of 29.5 million L (7.8 million gal). LERF receives aqueous waste through several inlets including the following:

- Pipeline that connects LERF with the 242-A Evaporator
- Pipeline from the 200 West Area
- Pipeline that connects LERF to the load-in station at the 200 Area ETF
- Series of sample ports located at each basin

Aqueous waste from LERF is pumped to the 200 Area ETF through one of two double-walled fiberglass transfer pipelines. Effluent from the 200 Area ETF also can be transferred back to LERF through one of these transfer pipelines. These pipelines are equipped with leak detection located in the annulus. This aqueous waste is pumped to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged

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[1] DOE/RL-2013-46, 2013, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw hanford.gov/arpir/index.cfm/viewDoc?accession=1406031319.

[2] WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste*, Revision 8c, as amended, Washington State Department of Ecology, Richland, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/permitting/hdwp/rev/8c/.

[3] *Resource Conservation and Recovery Act of 1976*, 42 USC 6901, et seq. Available at:http://www.epw.senate.gov/rcra.pdf.

[4] WAC 173-303-830, "Dangerous Waste Regulations," "Permit Changes," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-830.

[5] SGW-41072, 2017, *Liquid Effluent Retention Facility Engineering Evaluation and Characterization Report*, Rev. 1 pending, CH2M HILL Plateau Remediation Company, Richland, Washington.

to a State Approved Land Disposal Site, north of the 200 West Area, under the authority of Ecology, 2000,[6] and the 200 Area ETF delisting (40 CFR 261,[7] Appendix IX, Table 2).

Under interim status, indicator parameter groundwater monitoring was initiated at LERF in 1990 as described in WHC-SD-EN-AP-024 (Rev. 0).[8] The interim status groundwater monitoring network consisted of one upgradient well (299-E26-11) and three downgradient wells (299-E26-9, 299-E26-10, and 299 E35-2). The groundwater monitoring plan was revised in 1991 (Rev. 1), driven by the addition of site-specific parameters aluminum and ammonium. In 1994, another revision was approved, removing initial 40 CFR 265.92,[9] Appendix III parameters and aluminum and adding 1-butanol semiannually and alkalinity annually (ECN 603891[10]).

A final status, groundwater detection monitoring program (PNNL-11620[11]) in accordance with WAC 173-303-645[12] was submitted for incorporation with Revision 4 of the Hanford Facility RCRA Permit. Revision 4 was implemented January 28, 1998, incorporating LERF and 200 Area ETF as final status operating units. However, one of the LERF downgradient monitoring wells became sample dry in 1999. As a result, Ecology rejected the final-status groundwater monitoring plan (PNNL-11620) and reverted to the interim status monitoring plan (WHC-SD-EN-AP-024 with associated ECN 603891).

Continued water table declines from diminishing cooling water discharge at the 216-B-3 Pond, starting in 1988, led to the following: changes in groundwater quality, inability to sample 2 of the 3 downgradient wells, rethinking the conceptual model of the basalt hydraulic properties, and re-evaluating the basalt surface and groundwater flow direction beneath LERF. As a result of the inability to sample 2 of the 3 downgradient wells, Ecology suspended statistical evaluations of groundwater in 2001 and requested a new groundwater monitoring plan.

Between 2001 and 2004, DOE and Ecology evaluated alternative monitoring plans, developed and finalized a groundwater evaluation plan, and planned the implementation of the plan. In 2004, Ecology modified Revision 8 of the Hanford Facility RCRA Permit by adding Attachment 34, "Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility, and Approved Modification[13]." Attachment 34 called for determining the groundwater flow characteristics of the unconfined aquifer, including an

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[6] Ecology, 2000, *State Waste Discharge Permit Number ST 4500*, Washington State Department of Ecology, Kennewick, Washington. Available at: http://www.ecy.wa.gov/programs/nwp/pdf/4500dp.pdf.

[7] 40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-part261 xml.

[8] WHC-SD-EN-AP-024, 1991, *Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility*, Rev. 1, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw hanford.gov/arpir/index.cfm/viewDoc?accession=D196078225.

[9] 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol25/xml/CFR-2010-title40-vol25-sec265-92 xml.

[10] Engineering Change Notice 603891, 1995, *Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility*, change notice for WHC-SD-EN-AP-024, Rev. 1, Earth and Environmental Technical Services, Westinghouse Hanford Company, Richland, Washington. Available at: http://pdw hanford.gov/arpir/index.cfm/viewDoc?accession=D196034139.

[11] PNNL-11620, 1997, *Liquid Effluent Retention Facility Final-Status Groundwater Monitoring Plan*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www.osti.gov/scitech/servlets/purl/552795.

[12] WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303-645.

[13] WA7890008967, 2004, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion Revision 8*, Attachment 34, Washington State Department of Ecology, Richland, Washington. Available at: http://pdw hanford.gov/arpir/index.cfm/viewDoc?accession=D6170221.

assessment of barometric pressure fluctuations in the LERF monitoring wells and the potential for these fluctuations to affect hydraulic gradient and groundwater flow direction determinations.

In 2007, SGW-35756[14] directed field work which determined well 299-E26-11 was confined and well 299-E26-10 was unconfined. It was also determined that well 299-E26-11 had a significant effect on the trend-surface analysis because the water level elevation in 299-E26-11 was approximately 1 m (3.3 ft) higher than the other wells. An important recommendation in SGW-35756 was to correct for barometric effects in the two 2008 proposed LERF wells for a more accurate determination of long-term groundwater flow conditions.

In 2008, DOE/RL-2008-41[15] drove the installation and hydraulic testing of wells 299-E26-77 and 299-E26-79, which found fractured basalt flow top was hydraulically connected with the suprabasalt unconfined aquifer and had similar hydraulic properties. As a result, two geophysical investigations were initiated in 2010 to define the extent of the suprabasalt and fractured basalt aquifer and thickness.

Between 2010 and 2012, two geophysical investigations and three reports (SGW-52161,[16] SGW-52162,[17] and SGW-52467[18]) were completed, which included defining the basalt surface and suprabasalt sediments near and beneath LERF.

Upgradient well (299-E26-14) was installed later in 2011 based on the unconfined aquifer thickness defined by the geophysical investigation. The water level data from well 299-E26-14 were corrected for barometric effects and combined with water levels from other unconfined wells to define a southerly groundwater flow direction beneath LERF (ECF-HANFORD-12-0061[19], Section 2). These findings were used to complete the previous LERF monitoring plan (DOE/RL-2013-46, Rev. 0) and the proposed installation of well 299-E26-15.

In 2015, well 299-E26-15 was installed and permit condition III.3.R.3.b drove this revised detection monitoring plan in accordance with WAC 173-303-645(9).

This revised groundwater monitoring plan presents a detection monitoring plan for the uppermost aquifer beneath LERF and addresses the following items:

- Number, locations, and depths of wells in the LERF groundwater monitoring network
- Sampling and analytical methods required for groundwater detection monitoring of dangerous waste
- Methods for evaluating groundwater quality information

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14 SGW-35756, 2007, *Water-Level Barometric Response Analysis for the Liquid Effluent Retention Facility Monitoring Wells*, Rev. 0, Fluor Hanford, Inc., Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0906180656.

15 DOE/RL-2008-41, 2008, *Sampling and Analysis Plan for the Liquid Effluent Retention Facility (LERF) Replacement RCRA Well*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0808180154.

16 SGW-52161, 2012, *Resistivity and Electromagnetic Investigation at the LERF, 200 East Area of the Hanford Site, Richland, Washington*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0075561H.

17 SGW-52162, 2012, *Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

18 SGW-52467, 2012, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0073389H.

19 ECF-HANFORD-12-0061, 2013, *Groundwater Hydraulic Gradient and Velocity Calculations for 200 East Area RCRA Sites in 2011*, Rev. 0, CH2M Hill Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0071846H.

- Schedule for groundwater monitoring at LERF

As a background (upgradient) well, this plan uses existing well 299-E26-14. The two downgradient wells include well 299-E26-15 and well 299-E26-79. These wells are located at the point of compliance. The groundwater flow direction determinations indicate a southerly groundwater flow direction beneath LERF. Groundwater in the LERF monitoring wells will be sampled and analyzed quarterly for the first two years of the revised network, and semiannually after that, for the waste constituents used as a direct measurement of a release from LERF (1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine) to satisfy WAC 173-303-645(9)(a); regional upgradient constituents (sulfate and nitrate); well casing and groundwater quality parameters (metals: calcium, chromium, iron, magnesium, manganese, nickel, potassium, and sodium) and alkalinity; and field parameters (dissolved oxygen, oxidation reduction potential, pH, temperature, and turbidity). Water level measurements will be collected during each sampling event to determine the groundwater surface elevation as required by WAC 173-303-645(8)(f).

ADDENDUM D
GROUNDWATER MONITORING PLANS

TABLE OF CONTENTS

APPENDICES

FIGURES

TABLES

TERMS

AEA	*Atomic Energy Act of 1954*
CSM	conceptual site model
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EMB	Elephant Mountain Member of the Saddle Mountains Basalt
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration and Disposal Facility
ETF	Effluent Treatment Facility
FWS	Field Work Supervisor
HDPE	high-density polyethylene
HEIS	Hanford Environmental Information System
KGS	Kansas Geological Survey
LERF	Liquid Effluent Retention Facility
N/A	not applicable
NS	not sampled
OU	operable unit
OUG	operating unit group
QAPjP	quality assurance project plan
RCRA	*Resource Conservation and Recovery Act of 1976*
SVOC	semivolatile organic compound
TEDF	Treatment Effluent Disposal Facility
TOC TOX	total organic carbon total organic halogen
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UPR	unplanned release
VOC	volatile organic compound
WAC	*Washington Administrative Code*
XRF	X-ray fluorescence

D.1 INTRODUCTION

This document presents the revised groundwater monitoring plan for the Liquid Effluent Retention Facility (LERF). This document will supersede the previous plan (DOE/RL-2013-46, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility*, Rev. 0) upon modification of WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion for the Treatment, Storage, and Disposal of Dangerous Waste* (hereinafter referred to as the Hanford Facility RCRA Permit). LERF is an active operating unit in Part III, Operating Unit Group (OUG)-3, of the Hanford Facility RCRA Permit. A characterization report for monitoring well 299-E26-15, installed in 2015, in accordance with Part III, OUG-3, Permit Conditions III.3.R.3.c, III.3.R.3.c.1, III.3.R.3.c.2, and III.3.R.3.c.2.a is part of the content in SGW-41072, *Liquid Effluent Retention Facility Engineering Evaluation and Characterization Report*, Rev. 0. This monitoring plan complies with the Hanford Facility RCRA Permit, Part II General Facility Conditions (II.F), which specifies that the final status groundwater monitoring program requirements will comply with WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units." Groundwater is monitored in accordance with WAC 173-303-645 and Part III, OUG-3, of the Hanford Facility RCRA Permit. The LERF facility boundary is identified on the current Hanford Facility RCRA Permit Part A Form.

LERF is located adjacent to the northeast corner of the 200 East Area in the 200-BP-5 Operable Unit (OU) (Figure D-1). LERF and the 200 Area Effluent Treatment Facility (ETF) have worked together since 1995 as an aqueous waste treatment system that provides storage and treatment for a variety of aqueous mixed waste. Each of the three LERF basins has an operating capacity of 29.5 million L (7.8 million gal). LERF receives aqueous waste through the following inlets:

- Pipeline that connects LERF with the 242-A Evaporator
- Pipeline from the 200 West Area
- Pipeline that connects LERF to the Load-In Station at the 200 Area ETF
- Series of sample ports located at each basin

Aqueous waste from LERF is pumped to the 200 Area ETF through one of two double-walled fiberglass transfer pipelines. Effluent from the 200 Area ETF also can be transferred back to LERF through one of these transfer pipelines. These pipelines are equipped with leak detection located in the annulus. The aqueous waste is pumped from LERF to the 200 Area ETF for treatment in a series of process units, or systems, that remove or destroy essentially all of the dangerous waste constituents. The treated effluent is discharged to a State Approved Land Disposal Site, north of the 200 West Area, under the authority of a Washington State Waste Discharge Permit (Ecology, 2000, *State Waste Discharge Permit Number ST 4500*) and the 200 Area ETF Delisting (40 CFR 261, "Identification and Listing of Hazardous Waste," Appendix IX, Table 2).

Under interim status, indicator parameter groundwater monitoring was initiated at LERF in 1990 as described in WHC-SD-EN-AP-024, *Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility* (Rev. 0). The interim status groundwater monitoring network consisted of one upgradient well (299-E26-11) and three downgradient wells (299-E26-9, 299-E26-10, and 299-E35-2). The groundwater monitoring plan was revised in 1991 (WHC-SD-EN-AP-024, Rev. 1), driven by the addition of site specific parameters aluminum and ammonium. In 1994, another revision was approved, removing initial 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis," Appendix III parameters and aluminum and adding 1-butanol semiannually and alkalinity annually (ECN 603891, *Interim Status Groundwater Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility).*

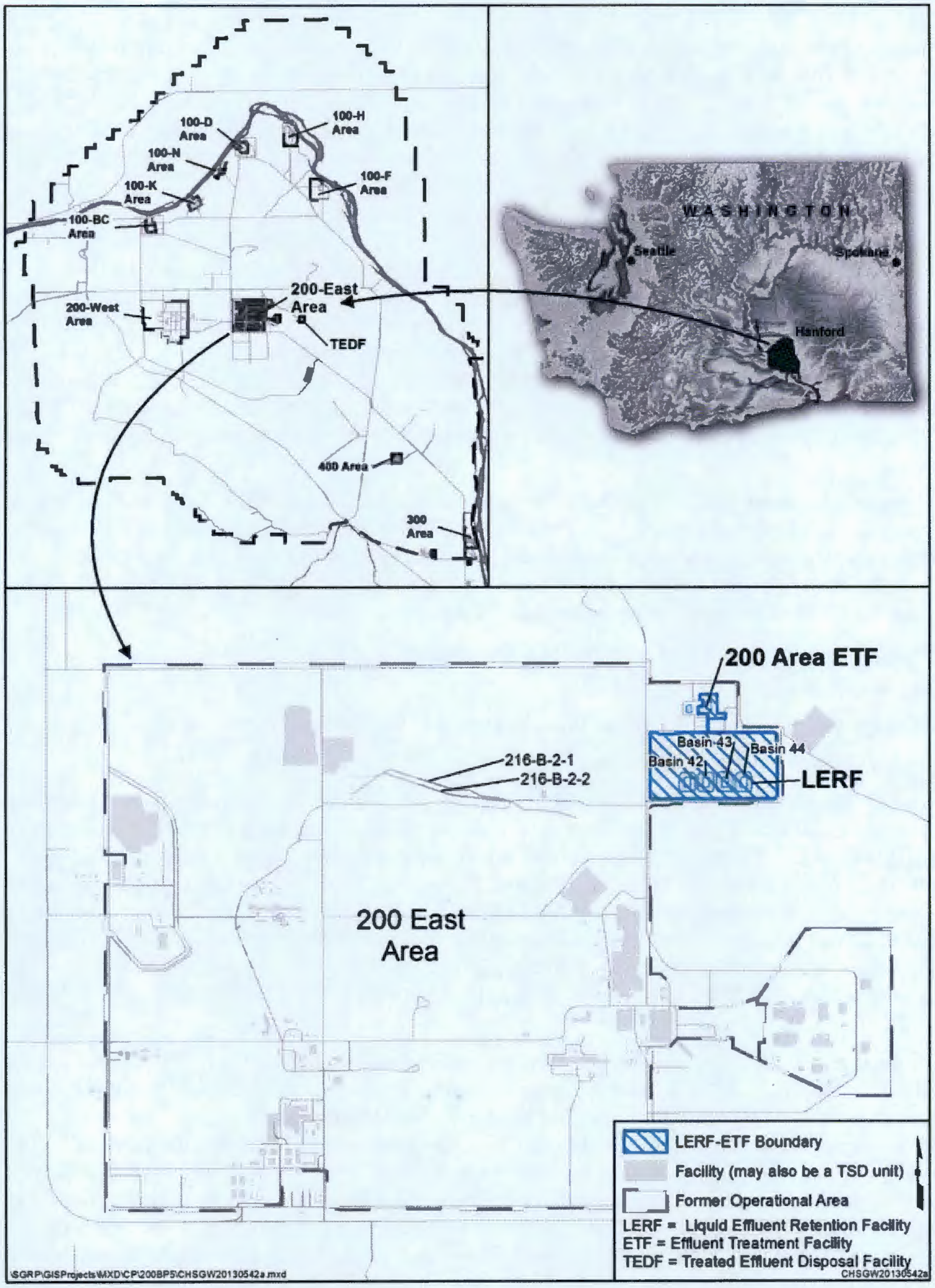


Figure D-1. Location Map for LERF

In 1994, Ecology issued the Hanford Facility RCRA Permit for the Hanford Site, which included the Part II General Facility Condition II.F requiring final status groundwater monitoring requirements, WAC 173-303-645. A final status detection monitoring plan under WAC 173-303-645 (PNNL-11620, *Liquid Effluent Retention Facility Final-Status Groundwater Monitoring Plan*) was submitted for incorporation with Revision 4 of the Hanford Facility RCRA Permit. Revision 4 was implemented on January 28, 1998 and incorporated LERF and the 200 Area ETF as final status operating units. However, in 1999 one of the LERF downgradient monitoring wells became sample dry. As a result, Ecology rejected the final status groundwater monitoring plan (PNNL-11620) and reverted to the WHC-SD-EN-AP-024 with associated ECN 603891.

Continued water table declines from diminishing cooling water discharge, starting in 1988, led to the following: changes in groundwater quality, ability to sample downgradient wells, conceptual model of the basalt hydraulic properties, change in basalt surface and groundwater flow direction. In 1999, groundwater quality changes west of LERF began to affect statistical evaluations for the detection monitoring indicator parameter, specific conductance. In 1999, PNNL, 1999, *Groundwater Assessment Plan and Report for the 200 East Area Liquid Effluent Retention Facility*, attributed the elevated specific conductance with decreased influence of 216-B-3 Pond radial migration and return of the aquifer in this area to natural background levels.

In 2001, per Ecology Letter (Goswami and Jamison, 2001, "Liquid Effluent Retention Facility (LERF) Unsaturated Zone Monitoring Alternatives Evaluation, Suspension of Groundwater Monitoring Statistical Evaluation Requirements, LERF RCRA Permit Modification, and Leachate Monitoring Performance Criteria," Ecology suspended statistical evaluations of groundwater monitoring as two of the three downgradient wells had become sample dry. Between 2001 and 2004, DOE and Ecology evaluated alternative monitoring plans, developed and finalized a groundwater evaluation plan, and planned the implementation of the plan. In 2004, Ecology modified Revision 8 of the Hanford Facility RCRA Permit by adding Attachment 34, "Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility, and Approved Modification," (WA7890008967, 2004, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion Revision 8)*. Attachment 34 called for determining the groundwater flow characteristics of the unconfined aquifer, including an assessment of barometric pressure fluctuations in the LERF monitoring wells and the potential for these fluctuations to affect hydraulic gradient and groundwater flow direction determinations.

In 2007, SGW-35756, *Water-Level Barometric Response Analysis for the Liquid Effluent Retention Facility Monitoring Wells*, directed field work that determined well 299-E26-11 to be confined and well 299-E26-10 to be unconfined. It was also determined that well 299-E26-11 had a significant effect on the trend-surface analysis because the water level elevation in 299-E26-11 was approximately 1 m higher than the other wells. An important recommendation in SGW-35756 was to correct for barometric effects in the two 2008 proposed LERF wells for a more accurate determination of long-term groundwater flow conditions.

In 2008, DOE/RL-2008-41, *Sampling and Analysis Plan for the Liquid Effluent Retention Facility (LERF) Replacement RCRA Wells* drove the installation and hydraulic testing of wells 299-E26-77 and 299-E26-79, which found fractured basalt flow top was hydraulically connected with the suprabasalt unconfined aquifer and had similar hydraulic properties. As a result, two geophysical investigations were initiated in 2010 to define the extent of the suprabasalt and fractured basalt aquifer and thickness.

Between 2010 and 2012, two geophysical investigations and three reports were completed, which included defining the basalt surface and suprabasalt sediments near and beneath LERF:

- SGW-52161, *Resistivity and Electromagnetic Investigation at the LERF, 200 East Area of the Hanford Site, Richland, Washington*
- SGW-52162, *Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington*
- SGW-52467, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington*

An upgradient well (299-E26-14) was installed in 2011 based on the unconfined aquifer thickness defined by the geophysical investigation. The water level data from well 299-E26-14 were corrected for barometric effects and combined with water levels from other unconfined wells to define a southerly groundwater flow direction beneath LERF (ECF-HANFORD-12-0061, Section 2, *Groundwater Hydraulic Gradient and Velocity Calculations for 200 East Area RCRA Sites in 2011*). These findings were used to complete the previous LERF monitoring plan (DOE/RL-2013-46, Rev. 0) and proposal of well 299-E26-15 installation.

In 2015, well 299-E26-15 was installed and permit condition III.3.R.3.b drove this revised detection monitoring plan, established in accordance with WAC 173-303-645(9). The purpose of this revised plan is to present an updated groundwater monitoring program that is capable of detecting a contaminant release to groundwater from LERF. This plan is intended specifically to satisfy monitoring requirements for final status OUG 3 as prescribed in Part II.F of the Hanford Facility RCRA Permit and as required by WAC 173-303-645. This document revision will supersede the previous version (DOE/RL-2013-46, Rev. 0) upon modification of the Hanford Facility RCRA Permit. This monitoring plan is the principal controlling document for conducting groundwater monitoring at LERF.

This revised plan monitors waste constituents, regional upgradient constituents, well casing and groundwater quality parameters, and field parameters. The waste constituents include: 1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine. The regional upgradient constituents were added to assess potential change in background conditions and include: anions (sulfate and nitrate). Parameters included to assess well casing/conditions and groundwater quality include the following: metals (calcium, chromium, iron, magnesium, manganese, nickel, potassium, and sodium) and alkalinity. The field parameters include: dissolved oxygen, oxidation reduction potential, pH, temperature, and turbidity. Water level measurements are required each time a sample is collected by WAC 173-303-645(8)(f).

This groundwater monitoring plan addresses the operational history, current hydrogeology, and conceptual site model (CSM) for the site and incorporates knowledge regarding contamination sent to LERF. Chapter 2 summarizes background information, the regulatory basis, types of waste present, pertinent geology and hydrogeology beneath LERF, and provides a brief history of groundwater monitoring. All of this information is summarized as the CSM to aid in development of the groundwater monitoring program. Chapter 3 describes the groundwater monitoring program, including the wells in the monitoring network, constituents analyzed, sampling frequency, and sampling protocols. Chapter 4 describes the data evaluation and reporting, Chapter 5 contains the references cited in this plan. Appendix A provides the quality assurance project plan (QAPjP), Appendix B contains sampling protocols, and Appendix C provides information for the wells within the groundwater monitoring network.

D.2 BACKGROUND

This chapter describes LERF and its operating history, regulatory basis, wastes and waste characteristics associated with LERF, local subsurface geology and hydrogeology, a summary of previous groundwater monitoring, and the CSM for LERF.

The information contained in this chapter was obtained from several sources, including the following documents:

- DOE/RL-90-43, *Liquid Effluent Retention Facility Dangerous Waste Permit Application*
- DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013*
- WHC-SD-W105-SAR-001, *Final Safety Analysis Report, Project W-105 Liquid Effluent Retention Facility*

D.2.1 Facility Description and Operational History

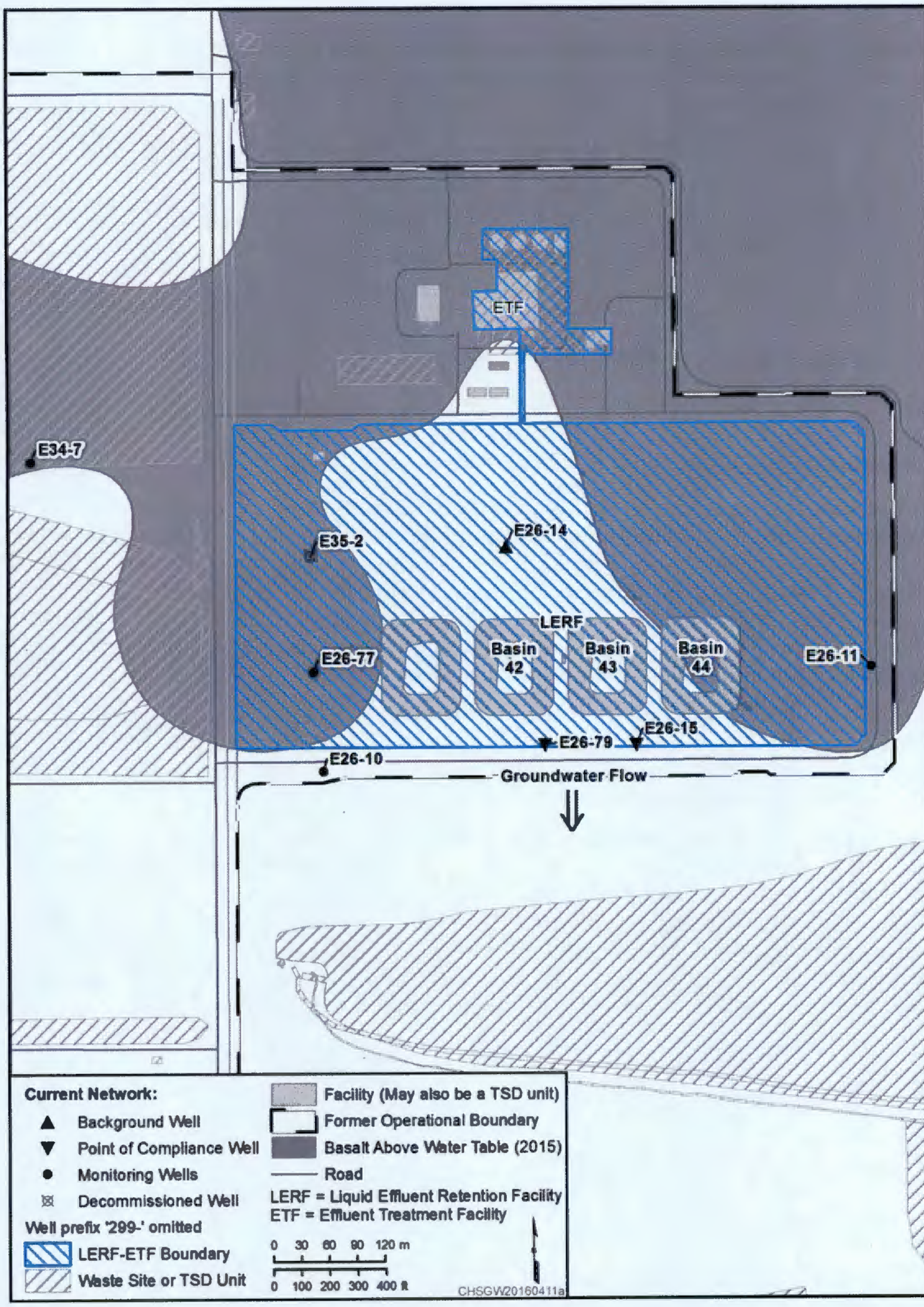
LERF is located in the central portion of the Hanford Site on the eastern boundary of the 200 East Area (Figure D-1).

D.2.1.1 Physical Description

Construction of LERF was completed in 1991. The LERF basins consist of three dangerous waste management units (Basins 42, 43, and 44) classified as surface impoundments (Figure D-2). The LERF design uses a dual confinement barrier concept (i.e., dual basin liners and pipe-in-a-pipe transfer piping system) to minimize the potential for accidental releases to the environment and human exposure. A leachate detection, collection, and removal system and basin covers are designed to reduce possible environmental or personnel exposures. The leachate detection system is monitored, as required by the LERF-200 Area ETF permit conditions and Addendum I of Part III, OUG-3, of WA7890008967.

LERF is a 15.8 ha (39 ac) site with three 2.9×10^7 L (7.8 million gal) capacity basins (Figure D-2). The basins are arranged side by side with 18.2 m (60 ft) separations between each basin. The dimensions of each basin (cell) are 100.5 by 82.2 m (330 by 270 ft), with a maximum fluid depth of 6.7 m (22 ft). The side slopes of the basin have a slope ratio of 3:1.

The primary liner for each basin is a geomembrane laid directly over a manufactured geotextile/bentonite carpet layer. The secondary liner is a 60 mil high-density polyethylene (HDPE) geomembrane laid directly on 0.9 m (36 in.) of a soil/bentonite mixture. The liners are separated by a synthetic drainage geonet laid on the sides of the basins, with 0.3 m (12 in.) of drainage gravel at the bottom. The sides slope to a sump, which is pumped when the liquid level reaches approximately 28 cm (11 in.) and shuts off when it drops to 18 cm (7 in.). Each basin has a mechanically tensioned cover of very low density polyethylene construction, which is anchored to the perimeter concrete ring wall of the basins with batten plates.



TSD= treatment, storage, and disposal

Figure D-2. 2015 LERF Monitoring Network and Groundwater Flow Direction

LERF employs a double-composite liner system with a leachate detection, collection, and removal system between the primary and secondary liners to reduce risk of leachate migration. Each basin is constructed with an upper or primary liner consisting of a 60 mil HDPE geomembrane laid over a manufactured geotextile/bentonite carpet liner. The lower or secondary liner in each basin is a composite of a 60 mil HDPE geomembrane liner laid directly on 0.9 m (36 in.) of a soil/bentonite mixture with a hydraulic conductivity <10^{-7} cm/s. The following liner components are listed from the top to the bottom:

- Primary 1.5 mm HDPE geomembrane
- Bentonite carpet liner
- Geotextile
- Drainage gravel (bottom) and geonet (sides)
- Geotextile
- Secondary 1.5 mm HDPE geomembrane
- Soil/bentonite mixture (91 cm on the bottom, 107 cm on the sides)
- Geotextile

The synthetic liners extend up the dike wall to a concrete anchor wall that surrounds the basin at the top of the dike. A batten system bolts the layers in place to the anchor wall. Below is a discussion on the degree of engineering and planning completed to ensure the liner system was not compromised.

Prior to and during construction of the LERF basins, precautions were taken by requiring contractors to submit construction quality control plans that included procedures, techniques, tools, and equipment used for the construction and care of liner and leachate system. Methods for installation of all components were screened to ensure that the stresses on the liner system were kept to a minimum.

A thin, nonwoven polypropylene fabric that is chemically resistant, highly permeable, and resistant to microbiological growth was placed initially to prevent the mixing of the soil/bentonite mixture with the much more porous and granular natural sediments (e.g., foundation material).

The next layer is 91 cm thick that transitions to 107 cm thick on the basin sidewalls. The soil/bentonite layer consists of 11.5 to 14.5 percent bentonite mixed into well-graded silty sand with a maximum particle size of 4.75 mm. During the laying of the soil/bentonite layer, moisture content of the mixture was monitored and adjusted to ensure optimum compaction and to avoid development of cracks. The high degree of compaction of the soil/bentonite layer (92 percent per ASTM D1557-02, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))*) was expected to maximize the bonding forces between the clay particles, thereby minimizing moisture transport through the liner. Tests were performed to confirm the soil/bentonite admixture applied at LERF had hydraulic conductivity <10^{-7} cm/second, as required by WAC 173-303-650(2)(j), "Surface Impoundments," for new surface impoundments. Initial settlement potential of the foundation material and soil/bentonite layer was found to be low based on DOE/RL-97-03 Rev. 0, *Hanford Facility Dangerous Waste Permit Application, Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility*. The combined settlement for the soils and the soil/bentonite layer is estimated to be about 2.7 cm.

Two 1.5 mm HDPE geomembranes that were chemically resistant and resistant to microbiological growth were placed above the soil/bentonite mixture. Installation of synthetic liner materials proceeded only when winds were less than 24 km/hour, and not during precipitation. The minimum ambient air temperature for unfolding or unrolling the sheets was -10°C, and a minimum temperature of 0°C was required for seaming sheets. Between shifts, geomembranes were anchored with sandbags to prevent lifting by wind. Calculations were performed to determine the appropriate spacing of sandbags on the geomembrane to resist lifting caused by 30 km/hr winds. All of the synthetic components contain ultraviolet light inhibitors, and no impairment of performance was anticipated from short-term ultra-violet light exposure during construction.

A 30.5 cm thick gravel drainage layer overlies the HDPE geomembranes associated with the secondary liner (or lowest/bottom liner). This gravel layer provides a flow path for liquid to the leachate detection, collection, and removal system. A geonet (or drainage net) is located immediately above the secondary geomembrane on the basin sidewalls. The geonet functions as a preferential flow path for liquid between the liners, carrying liquid down to the gravel drainage layer and subsequently to the leachate sump. The geonet is a mesh made of 20 mil HDPE, with approximately 13 mm openings.

D.2.1.2 Operational History

LERF was constructed for interim storage and treatment of aqueous waste streams prior to final treatment in the 200 Area ETF. Treatment at LERF consists of flow and pH equalization. Flow equalization allows for several smaller waste streams that are intermittently received at the LERF basins to accumulate for continuous higher volume campaign processing by the 200 Area ETF. The pH equalization allows uniform wastewater for optimizing the 200 Area ETF process campaigns.

LERF began receiving process condensate from the 242-A Evaporator in 1994. In 1995, several new liquid waste feeds were identified for treatment at LERF. These waste streams included Environmental Restoration and Disposal Facility (ERDF) leachate, purge water from groundwater monitoring, B Plant waste, and 200-UP-1 groundwater remediation. Between 2000 and 2013, the majority of liquid waste received at LERF was associated with the following in descending order: 200-UP-1/200-ZP-1 groundwater (181.4 million gal), ERDF leachate (16 million gal), process condensate from the 242-A Evaporator (7.3 million gal), mixed waste burial trenches leachate (2.9 million gal), K Basins (1.9 million gal), and purge water (1.8 million gal).

Projected 200 Area ETF influent waste streams for 2010 through 2028 are presented in HNF-23142, *Engineering Study for the 200 Area Effluent Treatment Facility Secondary Waste Treatment of Projected Future Waste Feeds*. HNF-23142 focuses on the 200 Area ETF's secondary treatment train alternatives for maintaining the viability of treating wastewaters generated as a result of the Hanford cleanup mission. HNF-23142 used influents from the waste treatment plant and supplemental low-level waste treatment process as bounding cases. The bounding evaluations are only associated with key constituents and are comparable to the concentrations discussed in Section D.2.3 of this plan.

D.2.2 Regulatory Basis

In 1986, DOE entered into a regulatory order (EPA and Ecology, 1986, EPA Regulatory Order No. 1085-10-07-3008 and Ecology No. DE 86-133) that mandated interim status groundwater quality assessment monitoring according to 40 CFR 265 and WAC 173-303-400, "Interim Status Facility Standards."

In May 1987, DOE issued a final rule (10 CFR 962, "Byproduct Material"), stating that the hazardous waste components of mixed waste are subject to RCRA regulations. The hazardous waste components of mixed waste were determined to be subject to Ecology authority to regulate these wastes since August 19, 1987.

In May 1989, DOE, the U.S. Environmental Protection Agency (EPA), and Ecology signed the Tri-Party Agreement (Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order*). The agreement established the roles and responsibilities of the agencies involved in regulating and controlling remedial restoration, and waste management, on the Hanford Site.

Dangerous waste is regulated under RCW 70.105, "Hazardous Waste Management," and its Washington State implementing regulations (WAC 173-303). Radionuclides in mixed waste may include source, special nuclear, and byproduct materials as defined in the *Atomic Energy Act of 1954* (AEA). AEA states that these radionuclide materials are regulated at DOE facilities, exclusively by DOE, acting pursuant to its AEA authority. Radionuclide materials are not hazardous/dangerous wastes and, therefore, are not subject to regulation by the State of Washington under RCRA or RCW 70.105.

Under interim status, indicator parameter groundwater monitoring was initiated at LERF in 1990 as described in WHC-SD-EN-AP-024 (Rev. 0). The monitoring plan was based on requirements for interim status facilities, as defined by RCRA and amended by Hazardous and Solid Waste Amendments of 1984. These regulations were promulgated by EPA in 40 CFR 265, Subpart F, "Ground-Water Monitoring," and by Ecology in WAC 173-303-400. The interim status groundwater monitoring network consisted of one upgradient well (299-E26-11) and three downgradient wells (299-E26-9, 299-E26-10, and 299-E35-2). The groundwater monitoring plan was revised in 1991 (WHC-SD-EN-AP-024, Rev. 1), driven by the addition of site specific parameters aluminum and ammonium. In 1994, another revision (ECN 603891) was approved, removing the initial 40 CFR 265.92, Appendix III parameters and aluminum and adding 1-butanol semiannually and alkalinity annually.

In 1994, Ecology issued the Hanford Facility RCRA Permit for the Hanford Site, which included the Part II General Facility Condition II.F requiring final status groundwater monitoring requirements under WAC 173-303-645. A final status detection monitoring plan (PNNL-11620), under WAC 173-303-645, was submitted for incorporation with Revision 4 of the Hanford Facility RCRA Permit. Revision 4 was implemented on January 28, 1998, incorporating LERF and the 200 Area ETF as final status operating units. However, one LERF downgradient monitoring well became sample dry in 1999. As a result, Ecology rejected the final status groundwater monitoring plan (PNNL-11620) and reverted to the interim status monitoring plan (WHC-SD-EN-AP-024 with associated ECN 603891).

Continued water table declines from diminishing cooling water discharge at the 216-B-3 Pond, starting in 1988, led to the following: changes in groundwater quality, inability to sample 2 of the 3 downgradient wells, rethinking the conceptual model of the basalt hydraulic properties, and re-evaluating the basalt surface and groundwater flow direction beneath LERF. Due to the inability to sample 2 of the 3 downgradient wells, Ecology suspended statistical evaluations of groundwater in 2001 at LERF and requested a new groundwater monitoring plan.

Between 2001 and 2004, DOE and Ecology evaluated alternative monitoring plans, developed and finalized a groundwater evaluation plan, and prepared for implementation of the plan. In 2004, Ecology modified Revision 8 of the Hanford Facility RCRA Permit by adding Attachment 34 (WA7890008967, 2004). Attachment 34 called for determining the groundwater flow characteristics of the unconfined aquifer, including an assessment of barometric pressure fluctuations in the LERF monitoring wells and the potential for these fluctuations to affect hydraulic gradient and groundwater flow direction determinations. In 2007, SGW-35756 directed field work, which determined that well 299-E26-11 was confined, and well 299-E26-10 was unconfined. It also determined that well 299-E26-11 had a significant effect on the trend-surface analysis because the water level elevation in 299-E26-11 was approximately 1 m higher than the other wells. DOE/RL-2008-41 was completed in 2008 and drove field work that determined the fractured basalt flow top was hydraulically connected with the suprabasalt unconfined aquifer and had similar hydraulic properties. Two geophysical investigations were initiated in 2010 to define the extent of the suprabasalt and fractured basalt aquifer and thickness. An upgradient well (299-E26-14) was installed in 2011, based on the unconfined aquifer thickness defined by the geophysical investigation.

The corrected barometric response for well 299-E26-14 was combined with information from other unconfined wells, defining a southerly groundwater flow direction beneath LERF (ECF-HANFORD-12-0061). These findings were used to complete the previous LERF monitoring plan (DOE/RL-2013-46, Rev. 0) and the proposed installation of well 299-E26-15. In 2015, well 299-E26-15 was installed, and permit condition III.3.R.3.b drove this revised detection monitoring plan, established in accordance with WAC 173-303-645(9).

D.2.3 Waste Characteristics

The 200 Area ETF was designed to treat a variety of aqueous wastes containing both chemical and radiological contaminants. This aqueous waste is collected in the three LERF basins prior to transfer to the 200 Area ETF to allow for efficient operations. Before a liquid waste can be transferred to the 200 Area ETF or LERF by a waste generator, a waste profile of the subject waste must be developed. This waste profile is compared against the 200 Area ETF/LERF acceptance criteria, as explained in Addendum B, "Waste Analysis Plan" of Part III, OUG-3, of WA7890008967. Waste streams that have been approved are also periodically re-evaluated for waste characteristics. Results of these periodic re-evaluations (provided in this subsection) help to identify reliable chemical contaminants that can be used for detection monitoring (as described in WAC 173-303-645(9)(a)). Below are the waste characteristics for the liquid effluents that have been historically stored in the three LERF basins (42, 43, and 44). The waste constituents selected for monitoring in this groundwater monitoring plan are identified as a part of the inventory screening in SGW-41072, *Liquid Effluent Retention Facility Engineering Evaluation and Characterization Report*, Rev. 1.

D.2.3.1 Basin 42

Various aqueous waste streams feed Basin 42; however, the 242-A Evaporator waste stream has been the largest volume waste stream associated with Basin 42. Between 1999 and 2012, the liquid volume associated with the 242-A Evaporator waste was 10 times that of any of the other waste streams sent to Basin 42. Maximum concentration limits for the 242-A Evaporator waste stream during the initial startup were provided in WHC-SD-W105-SAR-001. When maximum concentrations for the 242-A Evaporator waste stream (Table 9.6 of WHC-SD-W105-SAR-001) were compared with the average contaminant concentration levels (2009 through 2010 weighted average liquid concentrations) in Basin 42 (Table D-1), nearly all of the 2009 through 2010 weight average Basin 42 concentrations were lower than Table 9.6 of WHC-SD-W105-SAR-001. Constituents with greater concentrations were limited to two anions (chloride and sulfate), one cation (calcium), and four trace metals (barium, manganese, uranium, and zinc). These constituents appear to be associated with other waste streams such as the Mixed Waste Trenches 31 and 34 leachate and Hanford Site purge water, which had the second and third largest waste streams by volume. The other 17 waste streams associated with Basin 42 made up approximately 2 percent of the volume during this time frame.

Between 2013 and early 2016, 95 percent of the liquid waste sent to Basin 42 was again from the 242-A Evaporator. Results during this time frame were similar to those for 2009 to 2010 (Table D-1).

To determine the detectability of LERF Basin 42 waste constituents in groundwater per WAC 173-303-645(9)(a)(iii), The 200 Area ETF waste profile records were compared to Hanford Site regional background groundwater concentrations. The makeup of Basin 42 is similar to regional background groundwater concentrations, except for nitrogen from ammonium, and sulfate (see Table D-1 columns [e.g., 2009 Basin 42 Characterization Results and Basin 42 Average versus Regional Background Concentration of Table D-1]).

Table D-1. Basin 42 Constituent Characterization Results for Past 242-A Evaporator and Other Minor Source Leachates

Sample Location	2009-2010 Basin 42 Characterization Results					Maximum Characterization Results of Process Condensate to LERF Following 2009										Regional Groundwater Background Concentration[c]	Units	Constituents
	Units	Wtd Avg[a]		Max[b]		2010		2013		2014		2015		2016			Units	
Volume	gal	6.76E+06		6.87E+06		7.22E+0 5				1.35E+06		1.528E+06		4.16E+05			gal	
Nitrogen in Ammonium	mg/L	111.41		140		26.3		31		29.6		68		83		Not Listed	mg/L	Nitrogen in ammonium
Bromide	mg/L	0.07	U	0.09	U	0.05	U	0.016	U	NS		NS		NS		0.151	mg/L	Bromide
Chloride	mg/L	5.37		7.75		0.04	U	0.038	U	0.1		8.43		0.077		19.58	mg/L	Chloride
Fluoride	mg/L	0.05		0.06		0.06		0.001	U	0.033	U	0.119		0.033	U	1.298	mg/L	Fluoride
Nitrogen in Nitrate	mg/L	0.08		0.10		0.01		4.12		0.208		0.564		0.033	U	9.42	mg/L	Nitrogen in Nitrate
Nitrogen in Nitrite	mg/L	0.03	U	0.04	U	0.02	U	0.392		0.038	U	0.038	U	0.038	U	0.045	mg/L	Nitrogen in Nitrite
Phosphorus in Phosphate	mg/L	0.19		0.27		0.07	U	0.015	U	0.067	U	0.067	U	0.067	U	0.072	mg/L	Phosphorus in phosphate
Sulfate	mg/L	55.36		80.2		0.08	U	0.045		0.192		12.6		0.133	U	54.95	mg/L	Sulfate
Aluminum	µg/L	17.78	U	34	U	19	U	30	U	NS		NS		NS		170	µg/L	Aluminum
Antimony	µg/L	0.29	U	0.30	U	0.3	U	30	U	NS		NS		NS		69.8	µg/L	Antimony
Arsenic	µg/L	3.59		5.20		0.4	U	25	U	1.7	U	1.7	U	1.7	U	11.8	µg/L	Arsenic
Barium	µg/L	9.43		12.30		4	U	5	U	1.08		1	U	1	U	149	µg/L	Barium
Beryllium	µg/L	0.05	U	0.05	U	0.05	U	5	U	1	U	1	U	1	U	3.38	µg/L	Beryllium
Cadmium	µg/L	0.10	U	0.10	U	0.1	U	5	U	0.11	U	0.11	U	0.11	U	1.29	µg/L	Cadmium
Calcium	µg/L	10,692		18,000		27	U	400	U	238		50	U	50	U	58,389	µg/L	Calcium
Chromium	µg/L	5.52		7.9		0.5	U	5	U	2	U	2	U	2	U	3.17	µg/L	Chromium
Cobalt	µg/L	4.13	U	8.0	U	4	U	NS		NS		NS		NS		1.29	µg/L	Cobalt
Copper	µg/L	4.60		6.96		2.04		10	U	1.53		37.4		4.08		1.04	µg/L	Copper
Cyanide	µg/L	3.81	U	4.0	U	4	U	NS		NS		NS		NS		9.52	µg/L	Cyanide
Iron	µg/L	51.87		150		38	U	50	U	30	U	30	U	30	U	1104	µg/L	Iron
Lead	µg/L	1.33		9.01		3.52		30	U	6.88		4.08		3.5		1.3	µg/L	Lead
Magnesium	µg/L	2,533		5,100		14	U	10	U	110	U	110	U	110	U	31,051	µg/L	Magnesium
Manganese	µg/L	5.69		8.0		6	U	5	U	2	U	2	U	2	U	86.4	µg/L	Manganese
Mercury	µg/L	0.09		0.12		0.05	U	1.9		0.067	U	0.369		0.279		0.006	µg/L	Mercury
Nickel	µg/L	7.53		10.60		4	U	5	U	1.5	U	1.5	U	1.5	U	1.98	µg/L	Nickel
Potassium	µg/L	1,498		2,060		3	U	100	U	50.3		50	U	50	U	11,089	µg/L	Potassium
Selenium	µg/L	0.60		0.87		0.3	U	30	U	1.5	U	1.5	U	1.5	U	20.7	µg/L	Selenium
Silicon	µg/L	3,453.02		5,300		388		68.3		46.5		113		82.2		43,904	µg/L	Silicon
Silver	µg/L	5.38	U	10	U	7	U	5	U	1	U	1	U	1	U	5.98	µg/L	Silver
Sodium	µg/L	18,276		26,700		11	U	3,250		110	U	110		110	U	32,919	µg/L	Sodium
Thallium	µg/L	43.83		148		49	U	NS		NS		NS		NS		1.87	µg/L	Thallium

Table D-1. Basin 42 Constituent Characterization Results for Past 242-A Evaporator and Other Minor Source Leachates

Sample Location	2009-2010 Basin 42 Characterization Results					Maximum Characterization Results of Process Condensate to LERF Following 2009										Regional Groundwater Background Concentration[c]	Units	Constituents
	Units	Wtd Avg[a]		Max[b]		2010		2013		2014		2015		2016			Units	
Titanium	µg/L	4.13	U	8	U	4	U	NS		NS		NS		NS		30	µg/L	Titanium
Uranium	µg/L	8.54		13.4		0.05	U	100	U	0.067	U	0.067	U	0.067	U	14.4	µg/L	Uranium
Vanadium	µg/L	12.93	U	24	U	17	U	5	U	1	U	1	U	1	U	19.3	µg/L	Vanadium
Zinc	µg/L	12.93		17.6		4	U	20	U	3.3	U	7.13		19		48.9	µg/L	Zinc
Specific Conductance	µS/cm	430.52		583		45.1		NS		46.5		71.5		124		NS	µS/cm	Specific Conductance
pH Measurement	unitless	9.65		10.4		9.87		9.9		10.2		10.4		10.3		NS	unitless	pH Measurement
Alkalinity	µg/L	490		500		ND		NS		14.6-97.5		92.2-239		222-319		156,367	µg/L	Alkalinity
Total Dissolved Solids	µg/L	113.17		162		31		250		3.4	U	3.4	U	24.3		277,190	µg/L	Total dissolved solids
Total Suspended Solids	mg/L	2.49		10		10	U	NS		2.85	U	0.6	U	6.5		NS	mg/L	Total suspended solids
Total Organic Carbon	mg/L	7.10		9.59		4.39		20		3.45		10		7.54		To be determined statistically at LERF	mg/L	Total organic carbon
1-Butanol	µg/L	287		1,700		1,700		392		572		1,330		1,630		0	µg/L	1-Butanol
2-Butanone	µg/L	6.17		10.0		4.4		19		4.13		12.6		9.59		0	µg/L	2-Butanone
2-Pentanone	µg/L	3.34		5.70		5.7		1.98		NS		4.88		6.52		0	µg/L	2-Pentanone
Acetone	µg/L	220		1,700		260		236		119		216		1,020		0	µg/L	Acetone
Acetonitrile	µg/L	NS		NS		NS		NS		16.7	U	36.4		29.3		NS		
Benzene	µg/L	0.95	U	1.0	U	1.0	U	0.04		0.3	U	0.3	U	0.3	U	0	µg/L	Benzene
Carbon Tetrachloride	µg/L	0.95	U	1.0	U	1.0	U	0.1	U	0.3	U	0.3	U	0.3	U	0	µg/L	Carbon tetrachloride
Chloroform	µg/L	0.95	U	1.0	U	1.0	U	0.2		0.3	U	0.3	U	0.3	U	0	µg/L	Chloroform
Methylene Chloride	µg/L	1.16		1.60		1	U	0.044	U	1.6	U	1.72	BJ	1.6	U	0	µg/L	Methylene chloride
Tetrahydrofuran	µg/L	36.89		84		84		0.306	U	73.6		130		261		0	µg/L	Tetrahydrofuran
2-Butoxyethanol	µg/L	50.95		330		330		180		NS		NS		NS		0	µg/L	2-Butoxyethanol
2-Methylphenol (cresol, o-)	µg/L	1.26		4.30		4.3		NS		NS		NS		NS		0	µg/L	2-Methylphenol (cresol, o-)
Benzyl Alcohol	µg/L	3.06		23		6.7		NS		16.7	U	25.2		11.3		0	µg/L	Benzyl alcohol
n-Nitrosodimethylamine	µg/L	176		290		79		96	U	93.4		329		89.4		0	µg/L	n-Nitrosodimethylamine
Total Cresols	µg/L	0.95		4.30		4.3		28.9	U	16.7	U	3	U	2.97	U	0	µg/L	Total cresols
Tributyl Phosphate	µg/L	47.73		72		1	U	8.92	U	16.7	U	3	U	2.97	U	0	µg/L	Tributyl phosphate
Formate	µg/L	0.00	U	0.01		0.00629		NS		NS		NS		NS		0	pCi/L	Formate
Gross Alpha	pCi/L	136		190		2.3	U	NS		35.1		13.8		-1.02	U	0	pCi/L	Gross alpha
Gross Beta	pCi/L	23,218		34,000		2,100		NS		1,030		7,130		4,620		4.15	pCi/L	Gross beta

Table D-1. Basin 42 Constituent Characterization Results for Past 242-A Evaporator and Other Minor Source Leachates

Sample Location	2009-2010 Basin 42 Characterization Results					Maximum Characterization Results of Process Condensate to LERF Following 2009										Regional Groundwater Background Concentration[c]	Units	Constituents
	Units	Wtd Avg[a]		Max[b]		2010		2013		2014		2015		2016			Units	

Note: Spreadsheet data were provided by Effluent Treatment Facility personnel.

a. Weighted average for Basin 42 based on samples collected in Risers 2, 4, and 7 from June 2009, August 2010, and October 2010, respectively.

b. Maximum results are derived from the following sample dates: June 2009, August 2010, October 2010, September 2014, October 2014, May 2015, July 2015, September 2015, and April 2016.

c. Results are based on DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*.

Blank cells indicate no flags.

LERF = Liquid Effluent Retention Facility

N/A = not applicable

NS = not sampled

U = less than detection

Wtd Ave = weighted average

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The 200 Area ETF waste profile records for sulfate were much lower when compared with well 299-E34-7, which is crossgradient and upgradient to LERF. Elevated sulfate has been observed more recently at the LERF in upgradient well 299-E26-14 (Figure D-3). The location of wells 299-E26-14 and 299-E34-7 with respect to LERF are shown in Figure D-2. By comparison, the average concentration[20] of sulfate (55.6 mg/L) in Basin 42 is much less than the historical sulfate concentration of 671 mg/L at well 299-E34-7 (sample date 4/3/2003). The elevated sulfate in the unconfined aquifer appears to be associated with either the 216-B-2-1/216-B-2-2 unplanned releases (UPRs) (UPR-200-E-32 and UPR-200-E-138) and/or dissolution of gypsum from the liquid discharges to the vadose zone (see Section D.2.5). The comparison of sulfate in Basin 42 with wells 299-E26-14 and 299-E34-7 is provided to determine the detectability of this LERF waste constituent in groundwater per WAC 173-303-645(9)(a)(iii). Based on the much greater sulfate concentration in groundwater prior to the start of LERF and currently in upgradient well 299-E26-14 than that being sent to Basin 42, sulfate cannot be used to distinguish potential impacts to groundwater from LERF.

The 200 Area ETF waste profile records for nitrate were compared with groundwater wells crossgradient and upgradient (299-E34-7), upgradient (299-E26-14), and downgradient (299-E26-10) of LERF (Figure D-4). Nitrate associated with Basin 42 has historically been lower than 1 mg/L (Table D-1), while nitrate at the crossgradient/upgradient wells 299-E26-14 and 299-E34-7 exceed 50 mg/L. The elevated nitrate in the unconfined aquifer appears to be associated with the 216-B-2-1/216-B-2-2 UPRs (Section D.2.5). UPR200-E-32 and UPR-200-E-138 were associated with B Plant fractionation waste that had significant levels of nitrate. UPR-200-E-32 occurred in 1963 as a result of liquid storage tank coil leak in the 221-B Building, contaminating the sediments adjacent the unlined 216–B-2-1 Ditch. In 1970, UPR-200-E-138 was generated by the leaking 8-1 tank manometer sensing line in the 221-B Building, which flushed waste through the chemical sewer floor drain to the sediment adjacent to the unlined 216-B-2-2 Ditch. The above comparison of nitrate in Basin 42 with groundwater concentrations from wells 299-E26-14 and 299-E34-7 is provided to determine the detectability of this LERF waste constituent in groundwater per WAC 173-303-645(9)(a)(iii). Based on the much greater nitrate concentration in groundwater prior to the start of LERF and currently in upgradient well 299-E26-14 than being sent to Basin 42, nitrate cannot be used to distinguish potential impacts to groundwater from LERF. Nitrate and sulfate are not used to determine releases from LERF but they are sampled to get regional background levels.

Because nitrate and sulfate in the LERF groundwater conditions beneath LERF are indistinguishable from regional background values, both nitrate and sulfate are monitored as regional upgradient constituents. The elevated nitrate in the unconfined aquifer appears to be associated with either the 216-B-2-1/216-B-2-2 UPRs or natural fluvic or humic acids. The UPRs (e.g., UPR-200-E-32 and UPR-200-E-138) were associated with B Plant fractionation waste that had significant levels of organics. Specific conductance has also increased from the 1990s to 2016 in wells to the west, northwest and north of LERF, correlative with the increases in levels of nitrate and sulfate.

[20] All concentrations are reported as a weighted average.

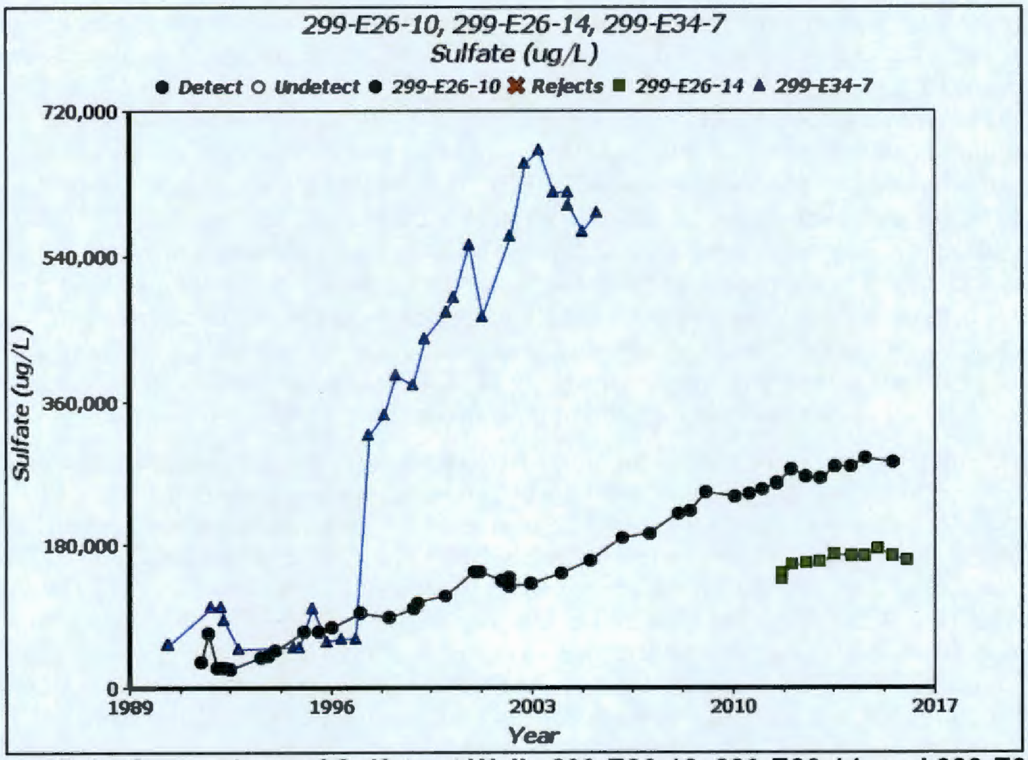


Figure D-3. Comparison of Sulfate at Wells 299-E26-10, 299-E26-14, and 299-E34-7

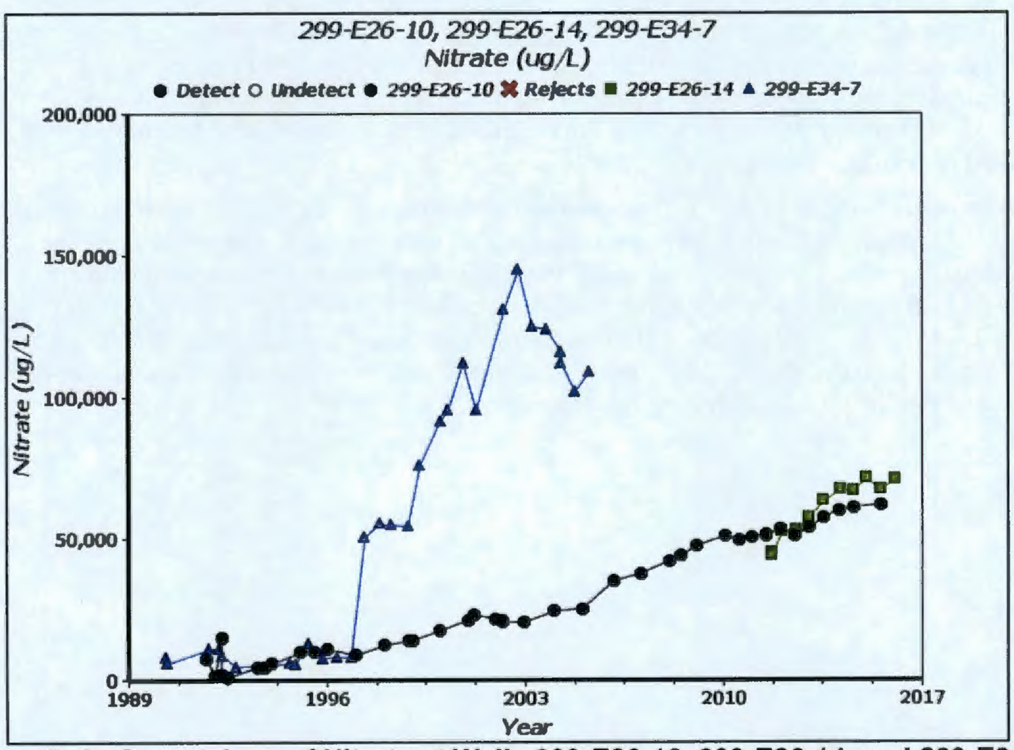


Figure D-4. Comparison of Nitrate at Wells 299-E26-10, 299-E26-14, and 299-E34-7

Dangerous waste metal constituents received at Basin 42 were evaluated to determine the detectability of LERF Basin 42 waste constituents in groundwater per WAC 173-303-645(9)(a)(iii). The 200 Area ETF waste profile records when compared to Hanford Site regional background groundwater concentrations (Table D-1) were similar to regional background groundwater concentrations, except for chromium, copper, lead, mercury, nickel, and thallium. Although the 200 Area ETF waste profile records are above the regional groundwater background levels, the results would not be detectable at groundwater compliance points should there be a potential release into the upper aquifer because of the low waste stream concentrations and dispersive effect associated with infiltrating waste through the vadose zone and into the groundwater (see Section D.2.6).

Likewise, the 200 Area ETF waste profile records for total organic carbon (TOC) are similar when compared with wells 299-E26-14, 299-E26-10, and 299-E26-7 (Figure D-5). TOC associated with Basin 42 has historically been 10 mg/L or less (Table D-1), while TOC at well 299-E26-14 (upgradient of LERF) and well 299-E34-7 (upgradient and cross gradient of LERF) has exceeded 5 mg/L. Basin 42 constituents such as 1-butanol and n-nitrosodimethylamine are ideal monitoring constituents, as they each routinely yield concentrations of hundreds of µg/L within LERF, but have not been detected in the regional groundwater (Table D-1).

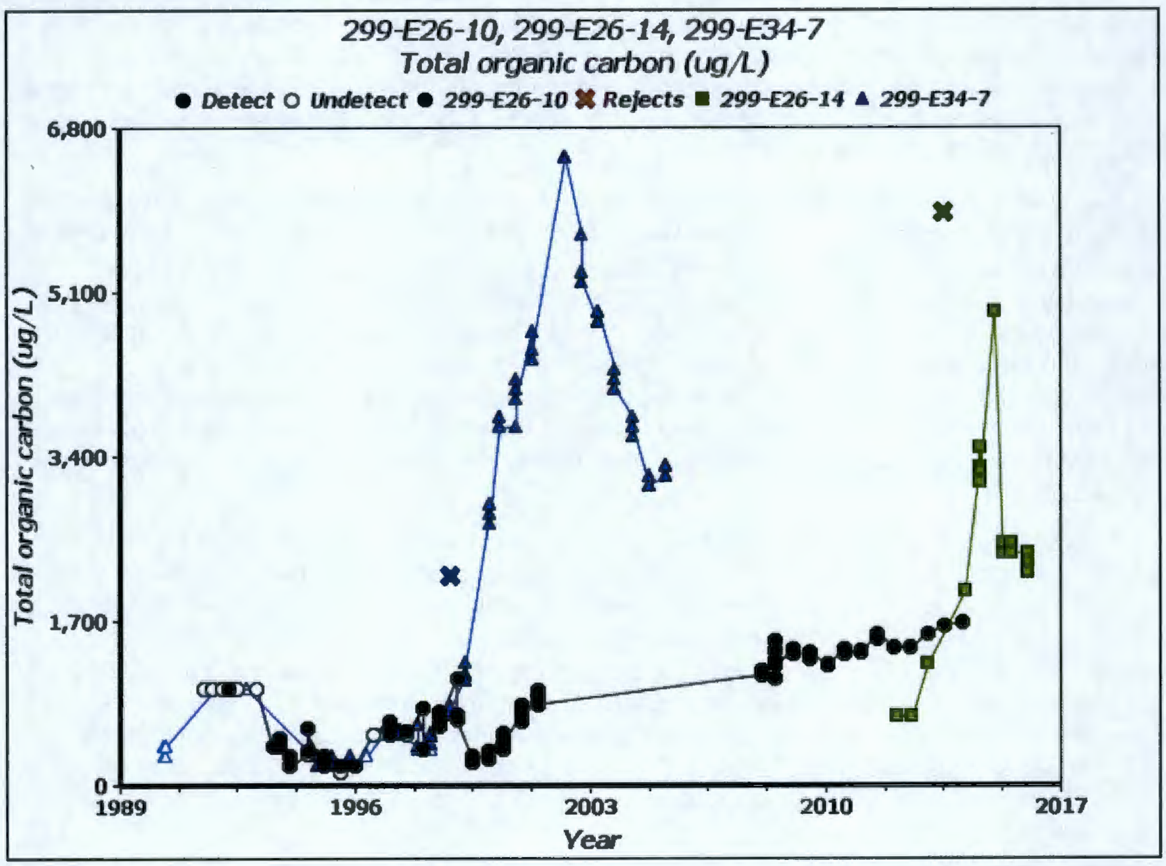


Figure D-5. Comparison of Total Organic Carbon at Wells 299-E26-10, 299-E26-14, and 299-E34-7

D.2.3.1.1 Basin 43

The largest volume of waste waters received by Basin 43 was contaminated groundwater from the 200-UP-1/200-ZP-1 OU groundwater pumping systems. The 200-UP-1/200-ZP-1 OU waste stream had

20 times more volume sent to LERF than the next closest waste stream (ERDF leachate) between 1995 and 2012. The 200-UP-1/200-ZP-1 OU groundwater effluent waste characteristics are contained in Table D-2. Table D-2 also provides characteristics of ERDF leachate in Basin 43 for 2012, after receipt of the 200-UP-1/200-ZP-1 OU groundwater effluent waste was terminated. ERDF leachate characteristics from 2014 and 2015 were similar to the 2012 results and are, therefore, not shown. Overall, the waste characteristics in Basin 43 are most comparable to the waste streams from 200-UP-1/200-ZP-1 OU groundwater pumping systems because of its significant volume compared with the other waste streams.

To determine the detectability of LERF Basin 43 waste constituents in groundwater per WAC 173-303-645(9)(a)(iii), the 200 Area ETF waste profile records were compared to Hanford Site regional background groundwater concentrations. The makeup of Basin 43 is similar to regional background groundwater concentrations, except for chloride, nitrogen from nitrate, sulfate, hexavalent chromium, and carbon tetrachloride (see Table D-2).

The 200-UP-1/200-ZP-1 OU waste streams had a nitrogen in nitrate weighted average concentration of 101 mg/L compared to 10 mg/L for the regional background groundwater concentration. Some of the other waste streams (e.g., ERDF leachate and 200-BP-5 perched water) received at Basin 43 also exceeded regional background groundwater results for chloride, nitrogen, and sulfate, with concentrations as great as 224.0 mg/L, 219.7mg/L, and 597.0 mg/L, respectively (Table D-2). However, these constituents are indistinguishable from current groundwater conditions beneath LERF, mainly because of the concentration of these constituents in the groundwater at locations both crossgradient and upgradient to LERF, as discussed in Section D.2.3.1.

Dangerous waste metal constituents received at Basin 43 were evaluated to determine the detectability of LERF Basin 43 waste constituents in groundwater per WAC 173-303-645(9)(a)(iii). The 200 Area ETF waste profile records (the first four columns of Table D-2) when compared to Hanford Site regional background groundwater concentrations (Table D-2) were similar to regional background groundwater concentrations, except for chromium, cobalt, copper, hexavalent chromium, lead, nickel, thallium, vanadium and zinc. Although the 200 Area ETF waste profile records are above the regional groundwater background levels, the results would not be detectable at groundwater compliance points should there be a potential release into the upper aquifer because of the low waste stream concentrations and dispersive effect associated with infiltrating waste through the vadose zone and into the groundwater (see Section D.2.6).

Of the 49 volatile and semivolatile constituents analyzed at various frequencies from 2008 to 2011 for liquid wastes sent to Basin 43, only three (carbon tetrachloride, chloroform, and trichloroethene) were detectable. The most significant constituent was carbon tetrachloride with concentrations ranging between 190 and 800 µg/L. The other two constituents had concentrations less than 10 µg/L. Since carbon tetrachloride is not normally occurring in the groundwater, it should be an excellent indicator of a release (see Section D.2.6). TOC ranged between 0.3 and 2.45 mg/L for liquid waste in Basin 43. Concentrations do not appear to be significant enough to differentiate a groundwater quality impact should a release reach groundwater.

Table D-2. Basin 43 Constituent Characterization Results for Past 200-UP-1 and 200-ZP-1 Groundwater Waste Streams and Recent Waste Characterization Results for Basin 43

Constituent	Units	200-UP-1 and 200-ZP-1 Groundwater[a]		Basin 43 Characterization Results[b]		ERDF Leachate[c]		200-BP-5 Perched Water[d]		Regional Groundwater Background Concentration[e]	Units
Volume	gal	7.03E+7[f]		9.13E+05							
Added Vol.	gal			1.26E+06		5.62E+05		2.36E+04			
Ammonium (N)	mg/L	0.064		0.1		0.1		NS		Not Listed	mg/L
Bromide	mg/L	0.4		1.2		1.5		1.2		0.151	mg/L
Chloride	mg/L	22.1		176.9		224.0		83.7		19.58	mg/L
Fluoride	mg/L	2.7		1.2		0.2		22		1.298	mg/L
Nitrate (N)	mg/L	101		63.8		64.6		219.7		9.42	mg/L
Nitrite (N)	mg/L	0.036	U	3.4	U	7.6	U	0.2	U	0.045	mg/L
Phosphate (P)	mg/L	0.12	U	0.2	U	0.3	U	0.3		0.072	mg/L
Sulfate	mg/L	57.2		404.4		597.0		556.4		54.95	mg/L
Aluminum	µg/L	44		17.5		19.7	U	125		170	µg/L
Antimony	µg/L	0.3	U	3.3	U	6.0	U	31	U	69.8	µg/L
Arsenic	µg/L	5.5		6.9		7.7		7.5		11.8	µg/L
Barium	µg/L	71.1		96.7		129.1		62.1		149	µg/L
Beryllium	µg/L	0.05	U	0.8	U	1.3	U	3	U	3.38	µg/L
Cadmium	µg/L	0.1	U	0.5		0.3		4.4		1.29	µg/L
Calcium	µg/L	56,861.5		181,161.2		248,000.0		167,000		58,389	µg/L
Chromium	µg/L	121.1		36.1		29.2		143.9		3.17	µg/L
Cobalt	µg/L	4	U	67.7		145.0		9		1.29	µg/L

Table D-2. Basin 43 Constituent Characterization Results for Past 200-UP-1 and 200-ZP-1 Groundwater Waste Streams and Recent Waste Characterization Results for Basin 43

Constituent	Units	200-UP-1 and 200-ZP-1 Groundwater[a]		Basin 43 Characterization Results[b]		ERDF Leachate[c]		200-BP-5 Perched Water[d]		Regional Groundwater Background Concentration[e]	Units
Copper	µg/L	0.15		121.1		145.0		21.7		1.04	µg/L
Hexavalent Chromium	µg/L	113		NS		NS		NS		NS	µg/L
Iron	µg/L	18	U	21.2		14.3		130.4		1104	µg/L
Lead	µg/L	0.1	U	5.1		10.9		NS		1.3	µg/L
Magnesium	µg/L	18,361.5		44,035.4		53,750.0		71,300		31,051	µg/L
Manganese	µg/L	4	U	7.1		6.9		129.7		86.4	µg/L
Mercury	µg/L	0.05	U	0.1		0.2	U	NS		0.006	µg/L
Nickel	µg/L	4	U	6.7		6.3		19.9	U	1.98	µg/L
Potassium	µg/L	5,536.2		13,579.6		17,138.0		10,100		11,089	µg/L
Selenium	µg/L	4.8		5.7		8.0		NS		20.7	µg/L
Silicon	µg/L	21,300		17,465.4		21,750.0		NS		43,904	µg/L
Silver	µg/L	5	U	5.5		5.0		33	U	5.98	µg/L
Sodium	µg/L	161,846.2		187,496.6		191,250.0		391,000		32,919	µg/L
Thallium	µg/L	36	U	27.7		5.0	U	NS		1.87	µg/L
Titanium	µg/L	4	U	4.4		4.0		NS		30	µg/L
Uranium	µg/L	25.6		2,249.2		1,100.6		43,500		14.4	µg/L
Vanadium	µg/L	38.5		32.9		45.1		17.4		19.3	µg/L
Zinc	µg/L	37.5		25.5		27.2		92.2		48.9	µg/L

Table D-2. Basin 43 Constituent Characterization Results for Past 200-UP-1 and 200-ZP-1 Groundwater Waste Streams and Recent Waste Characterization Results for Basin 43

Constituent	Units	200-UP-1 and 200-ZP-1 Groundwater[a]		Basin 43 Characterization Results[b]		ERDF Leachate[c]		200-BP-5 Perched Water[d]		Regional Groundwater Background Concentration[e]	Units
Specific Conductance	µS/cm	1,206.2		2,041.7		2,483.8		2,592		NS	µS/cm
pH Measurement	unitless	7.95		6.9		7.8		7.7		NS	unitless
Alkalinity	mg/L	151		224.9		296.0		231		156,367	µg/L
Total Dissolved Solids	mg/L	906.8		1,351.1		1,688.8		NS		277,190	µg/L
Total Suspended Solids	mg/L	1.62		9.7		19.4		NS		NS	mg/L
Total Organic Carbon	mg/L	0.64		6.0		6.4		NS		To be determined statistically at LERF	mg/L
Carbon Tetrachloride	µg/L	490.7		12.1		5.0	U	1.0	U	0	µg/L
Chloroform	µg/L	8.5		0.6	U	NS		1.0	U	0	µg/L
Trichloroethene	µg/L	≤6.6		≤6.6		<5		1.6		Not Listed	µg/L
Tetrahydrofuran	µg/L	2	U	1.1	U	NS		1.0	U	0	µg/L
Gross Alpha	pCi/L	29.4		1510.2		587.6		38,800		0	pCi/L
Gross Beta	pCi/L	2,830.8		8,065.1		394.8		34,600		4.15	pCi/L

Table D-2. Basin 43 Constituent Characterization Results for Past 200-UP-1 and 200-ZP-1 Groundwater Waste Streams and Recent Waste Characterization Results for Basin 43

Constituent	Units	200-UP-1 and 200-ZP-1 Groundwater[a]		Basin 43 Characterization Results[b]		ERDF Leachate[c]		200-BP-5 Perched Water[d]		Regional Groundwater Background Concentration[e]	Units

Notes: The second and fourth dominant waste streams were ModuTanks and Hanford purge water (2012 total to Basin 43 was 291,500 gal), which are the same streams and contain significantly less contaminant concentrations than ERDF leachate and 200-BP-5 perched water.

Spreadsheet data were provided by the 200 Area ETF personnel.

Blank cells indicate no flags.

a. 200-UP-1 and 200-ZP-1 average groundwater characterization results are based on up to 14 samples collected between 2008 and 2011.

b. Characterization results are of Basin 43 after removal of the 200-UP-1 and 200-ZP-1 groundwater from the basin. This groundwater waste stream is no longer being sent to LERF.

c. Represents the dominant waste stream for Basin 43 since 200-UP-1 and 200-ZP-1 groundwater transfers have ceased (2012 total to Basin 43 was 2,770,000 gal).

d. Represents the third most dominant waste stream received at Basin 43 (2012 total to Basin 43 was 130,000 gal).

e. Results are based on DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*.

f. Total volume of 200-UP-1 and 200-ZP-1 groundwater received between 2008 and 2011.

ERDF = Environmental Restoration and Disposal Facility

ETF = Effluent Treatment Facility

NS = not sampled

U = less than detectable

D.2.3.2Basin 44

Evaluation of Basin 44 prior to 2013 showed that Basin 44 had received liquid waste dominated by ERDF leachate (7 million gal or 60 percent by volume). Other significant liquid waste streams include K Basin waste (1.9 million or 16 percent by volume), leachate from double-lined burial trenches, Mixed Waste Trenches 31 and 34 located in 218-W-5 Burial Ground (1.2 million gal or 10 percent by volume), and purge water from well development (1.1 million or 10 percent by volume). Purge water and Mixed Waste Trenches 31 and 34 waste streams are lower in all constituents compared with ERDF leachate. Therefore, the waste in Basin 44 is most similar to ERDF leachate because of volume and concentration. From 2012 to 2016, Basin 44 did not receive any significant change in waste stream concentrations. Additional characterization in 2015 and 2016 is similar to the earlier results, so no additional data are provided in Table D-4.

To determine the detectability of LERF Basin 44 waste constituents in groundwater per WAC 173-303-645(9)(a)(iii), the 200 Area ETF waste profile records were compared to Hanford Site regional background groundwater concentrations. The makeup of Basin 44 is similar to regional background groundwater concentrations, except for chloride, nitrate, and sulfate (see Table D-3).

Table D-3. Basin 44 Constituent Characterization Results for Past ERDF Leachate

Chemical Abstracts Service No.	Constituent	Average Concentration between February 2000 and September 2012	Units	Regional Groundwater Background Concentration*	Units
7429-90-5	Aluminum	31	µg/L	170	µg/L
7440-36-0	Antimony	1	µg/L	69.8	µg/L
7440-38-2	Arsenic	9	µg/L	11.8	µg/L
7440-39-3	Barium	97	µg/L	149	µg/L
7440-41-7	Beryllium	0	µg/L	3.38	µg/L
7440-43-9	Cadmium	<0.1	µg/L	1.29	µg/L
7440-70-2	Calcium	213,735	µg/L	58,389	µg/L
7440-47-3	Chromium	27	µg/L	3.17	µg/L
7440-50-8	Copper	20	µg/L	1.04	µg/L
7439-89-6	Iron	35	µg/L	1,104	µg/L
7439-92-1	Lead	2.8	µg/L	1.3	µg/L
7439-95-4	Magnesium	69,580	µg/L	31,051	µg/L
7439-97-6	Mercury	0.154	µg/L	0.006	µg/L
7440-02-0	Nickel	13	µg/L	1.98	µg/L
7440-09-7	Potassium	20,573	µg/L	11,089	µg/L
7782-49-2	Selenium	5	µg/L	20.7	µg/L
7440-21-3	Silicon	20,063	µg/L	43,904	µg/L
7440-22-4	Silver	<5.0	µg/L	5.98	µg/L
7440-23-5	Sodium	254,237	µg/L	32,919	µg/L
7440-31-5	Tin	1	µg/L	23.6	µg/L

Table D-3. Basin 44 Constituent Characterization Results for Past ERDF Leachate

Chemical Abstracts Service No.	Constituent	Average Concentration between February 2000 and September 2012	Units	Regional Groundwater Background Concentration*	Units
7440-28-0	Thallium	0	µg/L	1.87	µg/L
7440-62-2	Vanadium	26	µg/L	19.3	µg/L
7440-66-6	Zinc	14	µg/L	48.9	µg/L
56-23-5	Carbon Tetrachloride	0	µg/L	0	µg/L
79-01-6	Trichloroethene	0	µg/L	0	µg/L
67-56-1	Methyl Alcohol	0	µg/L	0	µg/L
75-69-4	Trichlorofluoromethane	3.2	µg/L	0	µg/L
pH	pH	7 to 8	unitless	8.36	unitless
Conduct	Specific Conductance	2,509	µS/cm	NS	µS/cm
24959-67-9	Bromide	1,242	µg/L	151	µg/L
16887-00-6	Chloride	249.6	mg/L	19,580	µg/L
16984-48-8	Fluoride	521	µg/L	1,298	µg/L
14797-55-8	Nitrate	327.2	mg/L	41,723	µg/L
14797-65-0	Nitrite	500U	µg/L	130	µg/L
14808-79-8	Sulfate	473.7	mg/L	54,950	µg/L
TOC	Total Organic Carbon	13.2	mg/L	3,336	µg/L
OIL/GREASE	Oil and Grease	3,213	µg/L	0	µg/L
TDS	Total Dissolved Solids	1,926,897	µg/L	277,190	µg/L
TSS	Total Suspended Solids	15,686	µg/L	NS	µg/L
ALKALINITY	Alkalinity	264,813	µg/L	156,367	µg/L
12587-46-1	Gross Alpha	965	pCi/L	0	pCi/L
12587-47-2	Gross Beta	643	pCi/L	4.15	pCi/L

* Results are based on DOE/RL-96-61, *Hanford Site Background: Part 3, Groundwater Background*.

Note: Spreadsheet data were provided by Effluent Treatment Facility personnel.

NS = not sampled

TDS = total dissolved solids

TSS = total suspended solids

The ERDF waste stream is similar to Basin 43. The most comparable results are associated with chloride, nitrate, and sulfate. The average concentrations were 249.6 mg/L, 327.2 mg/L, and 473.7 mg/L, respectively (Table D-3). However, it is unlikely nitrate and sulfate would be distinguishable from current groundwater conditions beneath LERF, mainly because of the concentration of these constituents that are already present in groundwater at similar concentrations, both crossgradient and upgradient of LERF, as discussed in Section D.2.3.1.

Dangerous waste metal constituents received at Basin 44 were evaluated to determine the detectability of LERF Basin 44 waste constituents in groundwater per WAC 173-303-645(9)(a)(iii). The 200 Area ETF waste profile records when compared to Hanford Site regional background groundwater concentrations (Table D-3) were similar to regional background groundwater concentrations, except for chromium, copper, and nickel. Although the 200 Area ETF waste profile records are above the regional groundwater background levels, the results would not be detectable at groundwater compliance points should there be a potential release into the upper aquifer because of the low waste stream concentrations and dispersive effect associated with infiltrating waste through the vadose zone and into the groundwater (Section D.2.6).

Organic chemical analytical results associated with Basin 44 were at very low levels (<5 µg/L) and only periodically detected. Therefore, the ability to detect a potential release in the aquifer for organic chemicals is not practicable for the same reason as discussed for the metals and anions. TOC averaged 13.2 mg/L in Basin 44. TOC concentrations seem to be correlated with the elevated oil and grease results.

D.2.4 Geology and Hydrogeology

This section describes the geology, hydrogeology, and groundwater chemistry beneath the LERF area. To date, eight wells (299-E26-9, 299-E26-10, 299-E26-11, 299-E26-14, 299-E26-15, 299-E26-77, 299-E26-79, and 299-E35-2) have been installed since 1990 for monitoring groundwater quality beneath the LERF basins (Figure D-6). Geologist logs and regional geologic/hydrologic investigation were combined to define the stratigraphy and hydrologic characteristics beneath LERF. Documents used for defining geology and hydrogeology are provided in the following subsections. Table D-4 provides the well attributes for reference when reviewing this section.

D.2.4.1 Geology

The geology near LERF consists of Columbia River Basalt overlain by a series of sedimentary units of the Ringold Formation and Hanford formation. The interpretations are based on information from the following sources:

- BHI-00184, *Miocene- to Pliocene-Aged Suprabasalt Sediments of the Hanford Site, South-Central Washington*
- PNNL-12261, *Revised Hydrogeology for the Suprabasalt Aquifer System, 200-East Area and Vicinity, Hanford Site, Washington*
- PNNL-19702, *Hydrogeologic Model for the Gable Gap Area, Hanford Site*
- SGW-39344, *Borehole Summary Report for the Installation of RCRA Wells 299-E26-77 (C6455), 299-E26-79 (C6826), 299-E25-236 (C6542) and 199-N-165 (C6693), FY 2008*
- SGW-41072, Rev. 0, *Liquid Effluent Retention Facility Characterization Report*
- SGW-41072, Rev. 1, *Liquid Effluent Retention Facility Engineering Evaluation and Characterization Report*
- SGW-43746, *Landstreamer/Gimbaled GeoPhone Acquisition of High Resolution Seismic Reflection Data North of the 200 Area – Hanford Site*

- SGW-51467, *Borehole Summary Report for the Installation of Two RCRA Groundwater Monitoring Wells in the 200 Areas, FY2011*
- SGW-52162, *Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington*
- SGW-52467, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington*
- WHC-SD-EN-EV-024, *Site Characterization Report for the Liquid Effluent Retention Facility*
- WHC-MR-0235, *Borehole Completion Data Package for the Liquid Effluent Retention Facility*

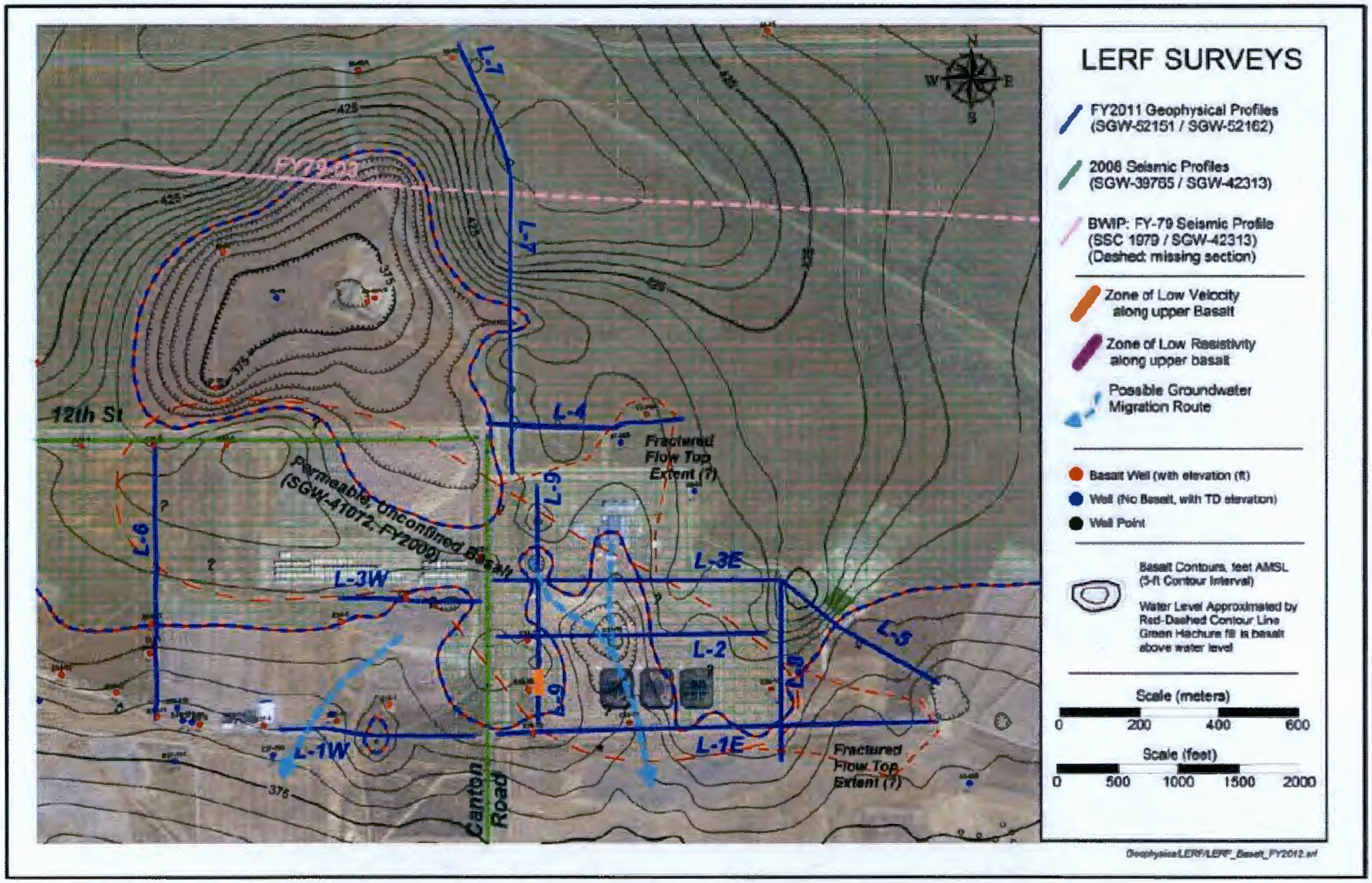
LERF lies in the Pasco Basin, between the axis of the Umtanum-Gable Mountain anticlinal ridge and the axis of the Cold Creek syncline. The terrain surrounding the LERF basins is flat to slightly undulating, and the average elevation is approximately 182 to 184 m (597 to 604 ft) above mean sea level.

The stratigraphy beneath LERF was interpreted from geologic observations during the drilling of eight boreholes, select analyses of sediment samples, aquifer tests, and geophysical investigations since 1990. The three principal stratigraphic units present beneath LERF, in ascending order, are the Elephant Mountain Member of the Saddle Mountains Basalt (EMB), Ringold Formation, and Hanford formation (Figure D-7). The thickness of suprabasalt sediments near the LERF basins ranges from 60 to 69 m (198 to 225 ft).

D.2.4.1.1 Elephant Mountain Member of the Saddle Mountains Basalt

The nature and extent of EMB, one of the youngest members of the Saddle Mountains Basalt and the uppermost basalt in this area, are based on results of observations and documentation of archive samples collected during drilling, X-ray fluorescence (XRF) analysis, seismic analyses, and hydraulic tests performed within the upper basalt flow top.

The EMB in this area was characterized in WHC-SD-EN-EV-024 as consisting of only the oldest EMB flow (Elephant Mountain I). This flow is generally continuous throughout the area, with a thickness ranging from approximately 12 m (39 ft) where partially eroded, to greater than 35.1 m (115 ft) north of the 200 East Area. The EMB I flow contains three intraflow structures: colonnade, entablature, and flow-top. The colonnade makes up the bottom third of the flow. The upper part of the colonnade grades from moderate- to well-developed columns into a platy cross-fractured colonnade and then into a hackly entablature. The entablature has numerous, irregular cross-fractures, vertical fractures, and small scattered vesicles near its top. The flow-top is characterized by abundant vesicles and is brecciated and/or palagonitic (WHC-SD-EN-EV-024). Because of the erosion in this area associated with ancestral Columbia River flow paths and later cataclysmic Ice Age flooding, large areas of basalt flow top have been removed. RHO-ST-38, *Geology of the Rattlesnake Ridge Interbed in the Gable Mountain Pond Area*, interpreted all basalt flow top as being removed north of the 200 East Area, though more recent boreholes near LERF have shown evidence the flow top still exists in the area.



Note: Figure is from SGW-52467, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington.*

Figure D-6. 2012 LERF Conceptual Model for Unconfined Aquifer Extent

Table D-4. LERF Well Attributes

Wells	299-E26-9	299-E26-10	299-E26-14	299-E26-15	299-E26-77	299-E26-79	299-E35-2
Date Drilled	August, 1990	August, 1990	September, 2011	June, 2015	October, 2008	September, 2008	August, 1990
Top of Casing Elevation (m/ft)	184.854/606.48	184.418/605.05	183.224/601.129	183.183/600.994	184.782/606.24	183.115/600.771	184.611/605.679
Ground Surface Elevation (m/ft)	183.941/603.48	183.512/602.07	182.494/598.734	182.404/598.438	184.011/603.371	182.356/598.281	183.712/602.73
Total Depth Drilled (m/ft)	61.722/202.5	62.972/206.6	73.334/240.6	63.063/206.9	70.957/232.8	68.507/224.76	61.661/202.3
Elevation of Total Depth Drilled (m/ft)	122.219/400.98	120.54/395.47	109.16/358.134	119.341/391.538	113.054/370.571	113.849/373.521	122.051/400.43
Depth to Top of Basalt (m/ft)	61.271/201.02	62.271/204.3	67.361/221	63.063/206.9	62.636/205.5	63.094/207	60.991/200.1
Top of Basalt Elevation (m/ft)	122.67/402.46	121.241/397.77	115.133/377.734	119.341/391.538	121.375/397.871	119.262/391.281	122.722/402.63
Bottom of Sump Elevation (m/ft)	None	None	115.773/379.834	None	114.334/374.771	114.325/375.081	None
Fill Below Bottom of Sump/Screen	20-40 Sand	20-40 Sand	Bentonite Pellets/ 10-20 Sand[a]	10-20 Sand	10-20 Sand	10-20 Sand	20-40 Sand
Bottom of Screen Elevation (m/ft)	122.707/402.58	120.693/395.97	116.688/382.834	119.484/392.008	115.248/377.771	115.239/378.081	122.295/401.23
Top of Screen Elevation (m/ft)	125.937/413.18	125.448/411.57	122.784/402.834	124.163/407.358	122.792/402.521	122.859/403.081	125.526/411.83
Sand Pack	20-40 Sand	20-40 Sand	10-20 Sand	10-20 Sand	10-20 Sand	10-20 Sand	20-40 Sand
Water Table Elevation After Drilling (m/ft)	124.444/408.28[b]	124.594/408.773[c]	121.922/400[d]	121.322/398.038	121.987/400.22[e]	121.976/400.184[f]	124.611/408.83[g]
Water Table Elevation 5/23/2016 (m/ft)	Dry	121.73/399.377	121.8/399.606	121.734/399.39	121.75/399.44	121.74/399.409	Dry
Water Height Across Screen 5/23/2016 (m/ft)	Dry	1.04/3.41	5.04/16.54	2.25/7.38	6.605/21.67	6.501/21.33	Dry
Water above Basalt 5/23/2016 (m/ft)	Dry	0.489/1.61	6.597/21.647	2.393/7.85	0.375/1.57	2.478/8.13	Dry
Ringold Present	No	No	Yes	No	No	Yes	Yes[h]
Depth to Top of Ringold (m/ft)	N/A	N/A	65.532/215	N/A	N/A	62.789/206	Not Provided
Top of Ringold Elevation (m/ft)	N/A	N/A	116.962/383.734	N/A	N/A	119.567/392.281	Uncertain
Thickness of Ringold Across Screen 4/10/2013 (m/ft)	N/A	N/A	0.274/0.9	N/A	N/A	0.3048/1	Uncertain
Best Estimate of Hydraulic Conductivity (m/day)	6 to 120	36.2 to 42.8	27.3	100	134	N/A[i]	39.7

a. Bentonite pellets to 0.7 ft below bottom of sump.

b. Date is 8/1/1990.

c. Date is 9/4/1990.

d. Date is 12/29/2011.

e. Date is 11/26/2008.

f. Date is 11/26/2008.

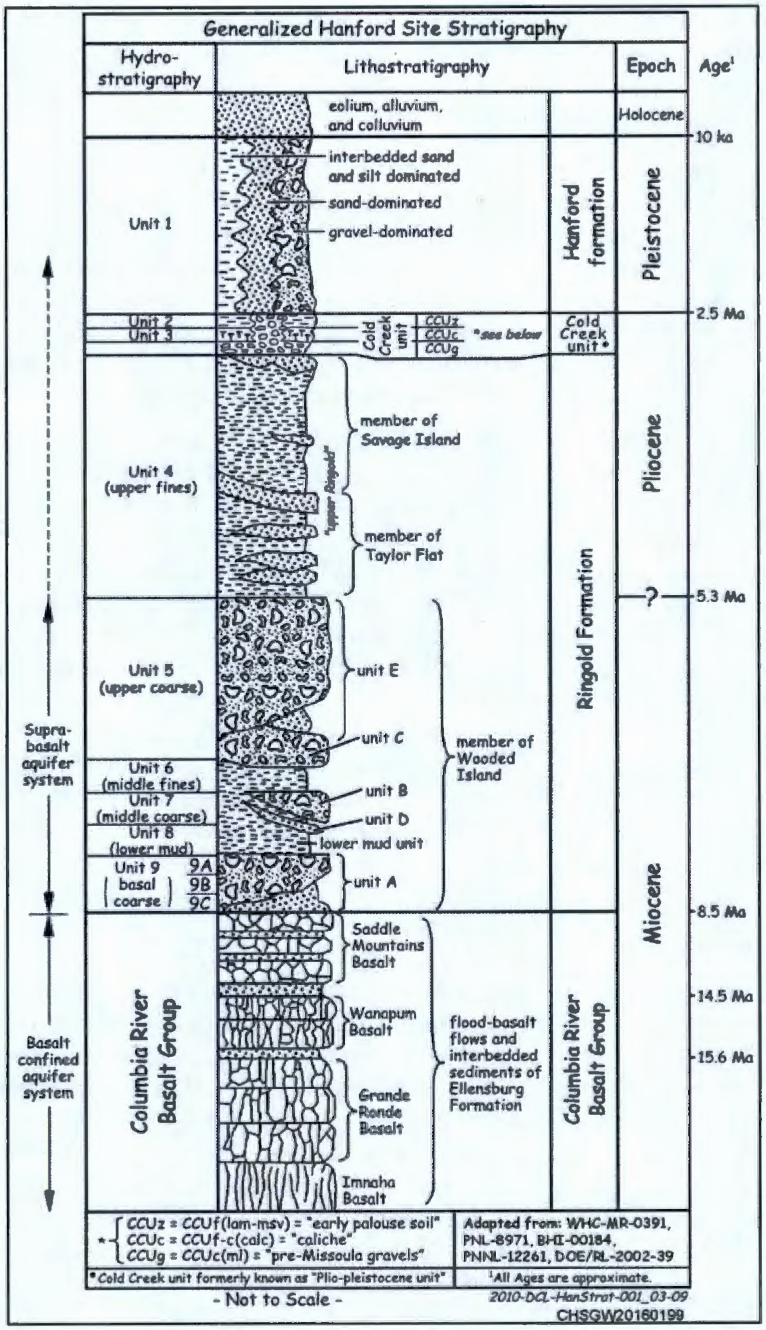
g. Date is 8/2/1990.

h. Basis is WHC-SD-EN-EV-024, *Site Characterization Report for the Liquid Effluent Retention Facility*.

i. Hydraulic conductivity is determined using AQTESOLV software. Slug test data for 299-E26-79 were not able to be fit by any AQTESOLV solution methods, see Section D.2.4.2 for more details.

N/A = not applicable

1



Note: Complete reference citations are provided in Chapter 5.

Figure D-7. Stratigraphy Beneath LERF

Observations during drilling near the LERF basins, when initially encountering the EMB surface, were described in WHC-MR-0235 as reddish weathered basalt with vesicles partially filled, except in wells 299-E26-9 and 299-E26-10, located to the west. However, well 299-E26-77, located next to well 299-E26-9, was reported with heavy weathering and the presence of vesicles (SGW-41072, Rev. 0). The drilling rate was moderate through the upper EMB to a depth of 2 to 3 m (6.6 to 9.8 ft) when drilling wells 299-E26-77 and 299-E26-79, respectively (SGW-39344). SGW-41072, Rev. 0, concluded that hydraulic communication of the uppermost aquifer (e.g., unconfined) extends from suprabasalt sediments into the basalt, at least in the western half of LERF, because there was no impediment associated with the overlying Hanford formation sediments. The thickness of the flowtop was interpreted to range from 2 m (6.6 ft) at well 299-E26-77 (west of LERF) to 3.2 m (10.5 ft) at well 299-E26-79 (south of LERF), and 1.5 m (5 ft) at well 299-E26-11 (east of LERF).

The top of the EMB in the immediate vicinity of the LERF basins forms a depression centered at well 299-E26-14 (Figure D-6). Structurally, the basalt beneath LERF is the known southeastern extension of a series of second-order folds contained between the Cold Creek syncline and Gable Mountain anticline. Conceptually, this northwest-southeast trending structural feature appears to have contributed to past preferential drainage. The contours presented in Figure D-6 are based on a combination of basalt contact during drilling and various geophysical investigations (e.g., seismic reflection and refraction, electrical resistivity, and time-domain electromagnetic sounding). Seismic results to the east and west of well 299-E26-14 portray limited aquifer conditions above the basalt (Figure D-8).

Paleochannels are interpreted to the north and northwest of well 299-E26-14 and continued to the south-southeast, as displayed in Figures D-6 and D-9. Seismic reflection results suggest an even deeper depression to the east of well 299-E26-79, centered almost directly south of Basin 43, with as much as 8 m (26 ft) of aquifer thickness (Figure D-10, black line in figure provides the interpreted top of basalt). Continuing east of this depression on the south side of LERF, the basalt surface is interpreted to rise to the current water table level, just east of well 299-E26-15. The apparent contact with the water table is estimated to be just south of the west boundary of Basin 44; based on the estimated amount of aquifer present by the geophysics information at well 299-E26-15 versus the amount of aquifer observed in the field, the geophysics is accurate within an apparent 0.3 to 0.61 m (1 to 2 ft). Also, well 299-E26-15 provided additional data along the apparent south-southeast trending ancestral paleochannel in the basalt surface as defined in Figure D-6 and D-11. More discussion of well 299-E26-15 is provided in Rev. 1 of SGW-41072. Further east, the basalt is interpreted to plateau to beyond well 299-E26-11. There does not appear to be fractured basalt present to the southeast of Basin 44. West of well 299-E26-79, the basalt surface is interpreted to increase in elevation linearly to the elevation of 121.3 m (398 ft) at well 299-E26-10.

D.2.4.1.2 Ringold Formation

The Ringold Formation represents ancient fluvial and lacustrine deposits associated with the ancestral Columbia River, and the formation exhibits consolidation and weathering. Where present, this formation overlies the EMB (Figure D-11). According to WHC-SD-EN-EV-024, remnant muds associated with the Ringold period exist to the east and northwest of the LERF site at wells 299-E26-11 and 299-E35-2, respectively. DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report*, reported approximately 2.74 m (9 ft) of the Ringold Lower Mud Unit in well 299-E26-11 and mapped the Lower Mud Unit extending to this location from the east. BHI-00184 identified the Ringold muds east of the 200 East Area as paleosol overbank deposits. WHC-SD-EN-EV-024 concluded that the sediment layer was a paleosol based on XRF analysis. BHI-00184 states that pedogenically altered silt-and clay-rich overbank-paleosol (facies association III) deposits of the Ringold Formation are easily distinguished from the basalt-rich sand and gravel of the Hanford formation. In 2000, PNNL-12261 defined the sediments near well 299-E26-11 hydraulically as the Ringold Formation Unit A (Figure D-11).

The Ringold sediment at well 299-E26-11, as described in WHC-MR-0235, consists of a slightly gravelly sandy mud (5 percent gravel, 30 percent sand, and 65 percent mud). The color was reported as very dark grayish brown (10YR3/2). The gravel content was described as 90 percent mafic, and the sand content was 50 percent mafic. The sediments had no reaction to hydrochloric acid.

During drilling of well 299-E26-14, low permeability sediments were encountered at 65.5 to 66.1 m (215 to 217 ft) below ground surface. The sediments were described as 95 percent silt and 5 percent gravel. Photographic review of this sediment layer, presented in SGW-51467 (Appendix B), shows a distinct texture and color change from the overlying Hanford sandy gravels. The reddish brown hue and yellow tints associated with this layer correlate well with the distal overbank description provided in BHI-00184. Other characteristics associated with this layer included no reaction to hydrochloric acid, similar to Ringold sediments described at well 299-E26-11. An alternative explanation may be that the apparent Ringold sediments are rework, removed from one location and deposited at this location, possibly associated with cataclysmic glacial fluvial floods.

Most of the area beneath LERF, including that at well 299-E26-15, is considered devoid of Ringold sediments because of the high energy scouring associated glacial fluvial flooding in the Pleistocene and the lack of reflectors in the suprabasalt section during 2011 seismic data reviews. PNNL-19702 presents a conceptual model of various paleochannels originating to the northwest (Figure D-9). Some of these paleochannels may have been formed during Ringold times, and isolated remnants of Ringold sediments are sometimes found within these older paleochannels.

D.2.4.1.3 Hanford Formation

The Hanford formation near LERF ranges in thickness from approximately 59 to 66 m (193 to 215 ft) or more. The texture of the Hanford formation is loose to weakly cemented, muddy sandy, pebble-cobble gravels to gravelly sand, with occasional layers of sand and/or muddy sand. Regionally, the Hanford formation is subdivided into an upper gravel sequence (H1), a sandy sequence (H2), and a lower gravel sequence (H3). The sandy sequence is present locally and where it is missing, a single sequence of gravel-dominated facies exists, differentiated in cross-sections at well 299-E26-11 by the cleaner gravels below and muddier gravels above (Figures D-11 and D-12).

LERF is located along the southern flank of a major west-northwest/east-southeast trending cataclysmic flood channel (Figure D-9). In general, more silt or mud was present to the west and east than north or south of the LERF basins; however, high silt and clay content to the north and south of LERF was present within the aquifer near the contact with the EMB. These silt and clay layers ranged in thickness between 0.3 to 1.5 m (1 to 5 ft) and appear to be of Ringold age, as discussed in Section 2.4.1.2. The basalt content in layers above the silt and clay indicates Hanford origin. Above these initial silt and clay layers, where present, or the EMB, the gravel content was generally about 60 percent, consisting of 40 to 70 percent mafics. This is consistent with the observations at well 299-E26-15, as can be seen in sediment grab sample photographs at approximately 1.5 m (5 ft) intervals throughout the borehole (SGW-59346, *Borehole Summary Report for the Installation of Eight M-24 Tri-Party Agreement Groundwater Monitoring Wells FY 2015*). Significantly more cobbles were described in the north and south LERF boreholes than to the east and west LERF boreholes as captured in the borehole log descriptions. The grayish brown to very dark grayish brown color description of the sediments was consistent throughout the area. Calcium carbonate levels are low to within 21 m (70 ft) of ground surface, based on little to no reaction to hydrochloric acid. The upper zone increase in calcium carbonate levels correlates with low modeled velocities during refraction and resistivity modeling, as stated in SGW-52467, and may be a distinctive feature to differentiate the H1 and H3 in this area. Moisture observations ranged from dry to wet; however, the damp and wet descriptions in the vadose zone pertained to zones where water was added during drilling. In conclusion, the larger gravel size, to the north and south of the LERF basins, appears to align with the west-northwest/east-southeast trending cataclysmic flood channel conceptual model in PNNL-19702 (Figure D-9). There were no significant zones of silt or clay above the aquifer indicating no perching horizons in the suprabasalt sediments beneath the LERF vicinity.

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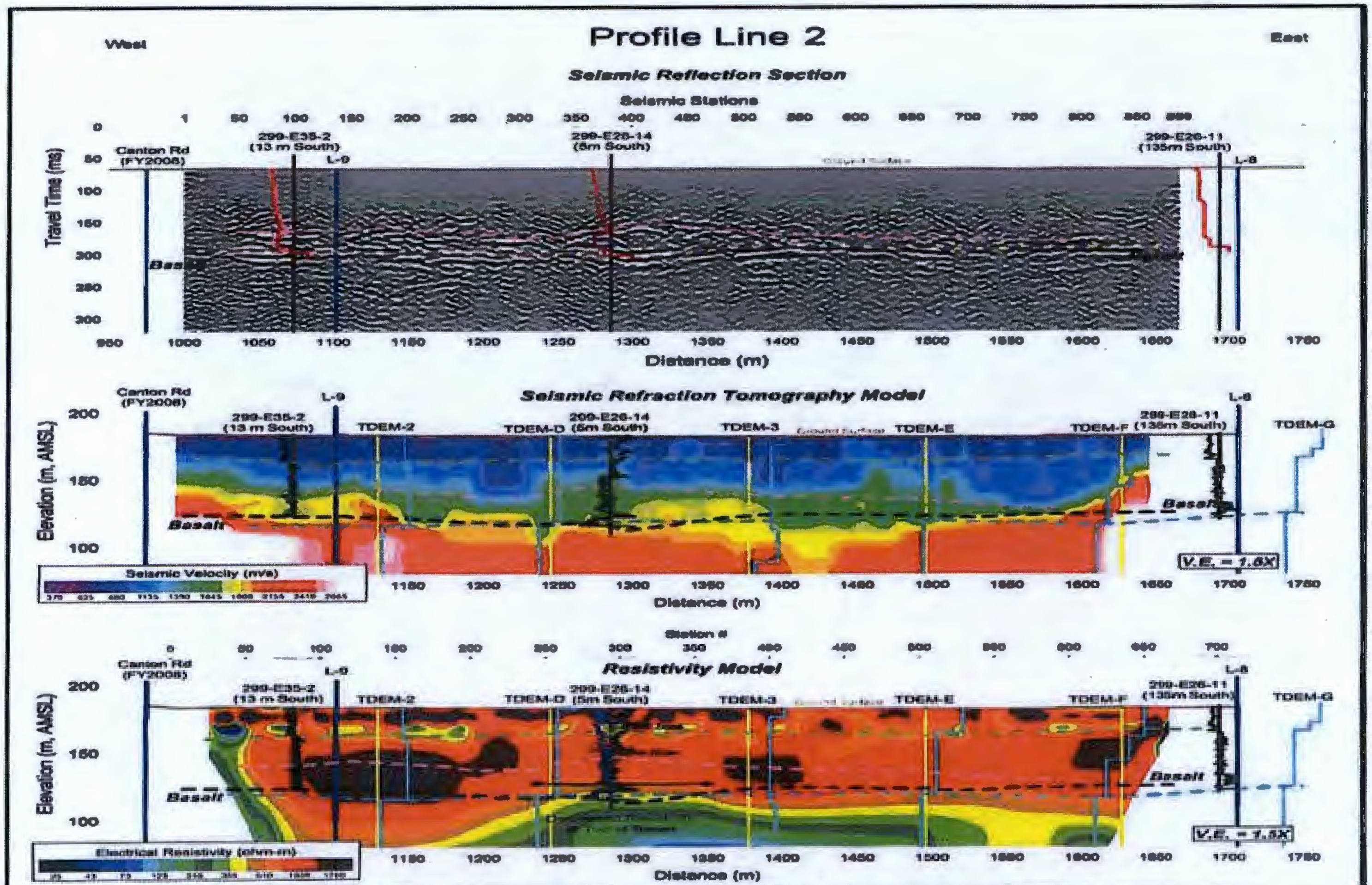
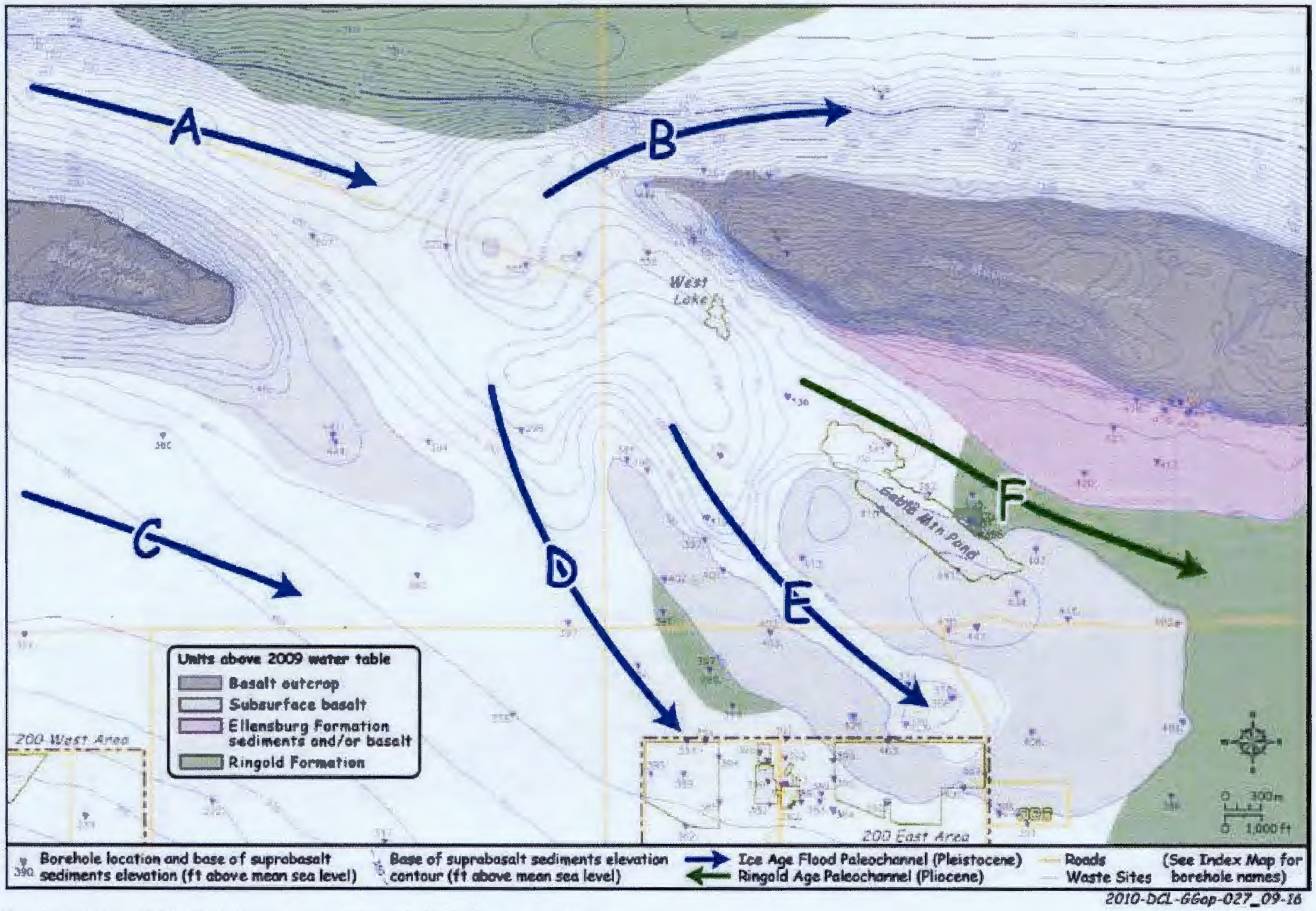


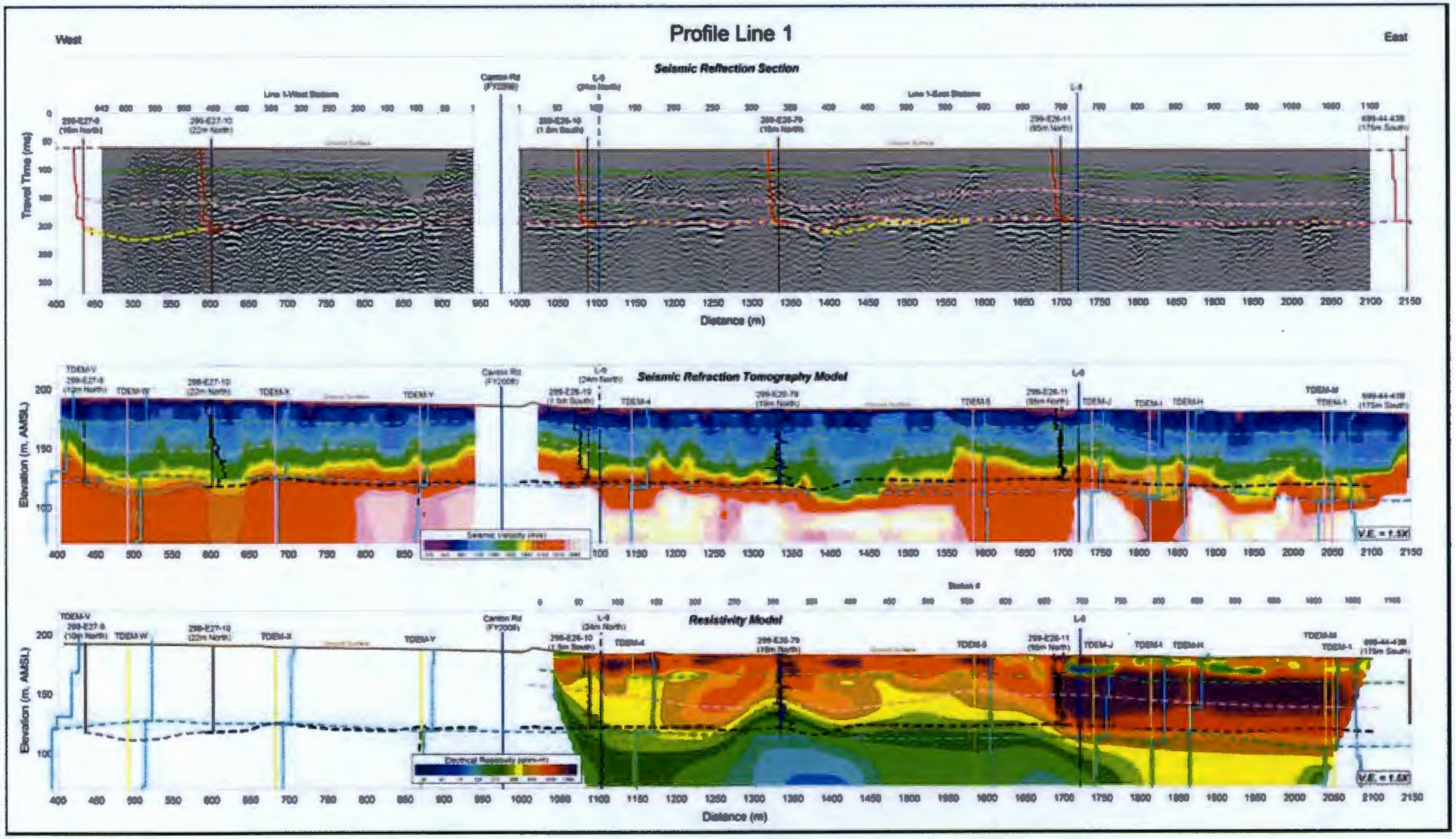
Note: Figure is from SGW-52467, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington.*

Figure D-8. Seismic Profile North of LERF Extending from Well 299-E35-2 to Well 299-E26-11 and Including Well 299-E26-11



Note: Figure is from PNNL-19702, *Hydrogeologic Model for the Gable Gap Area, Hanford Site.*

Figure D-9. Buried Paleochannels within the Gable Gap Area



Note: Figure is from SGW-52467, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington.*

Figure D-10. Seismic Profile South of LERF with Focus on Area between Wells 299-E26-10 and 299-E26-11

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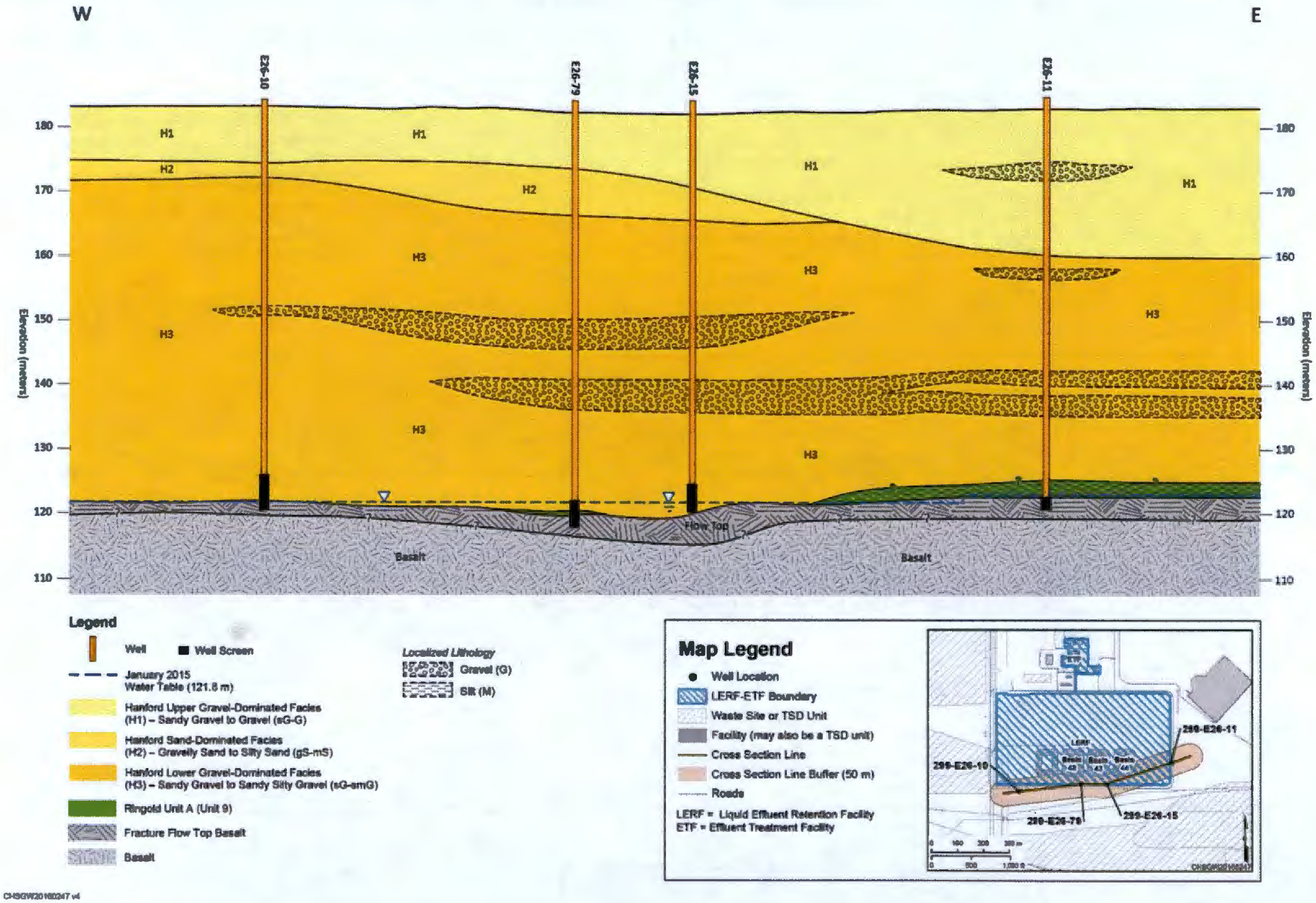
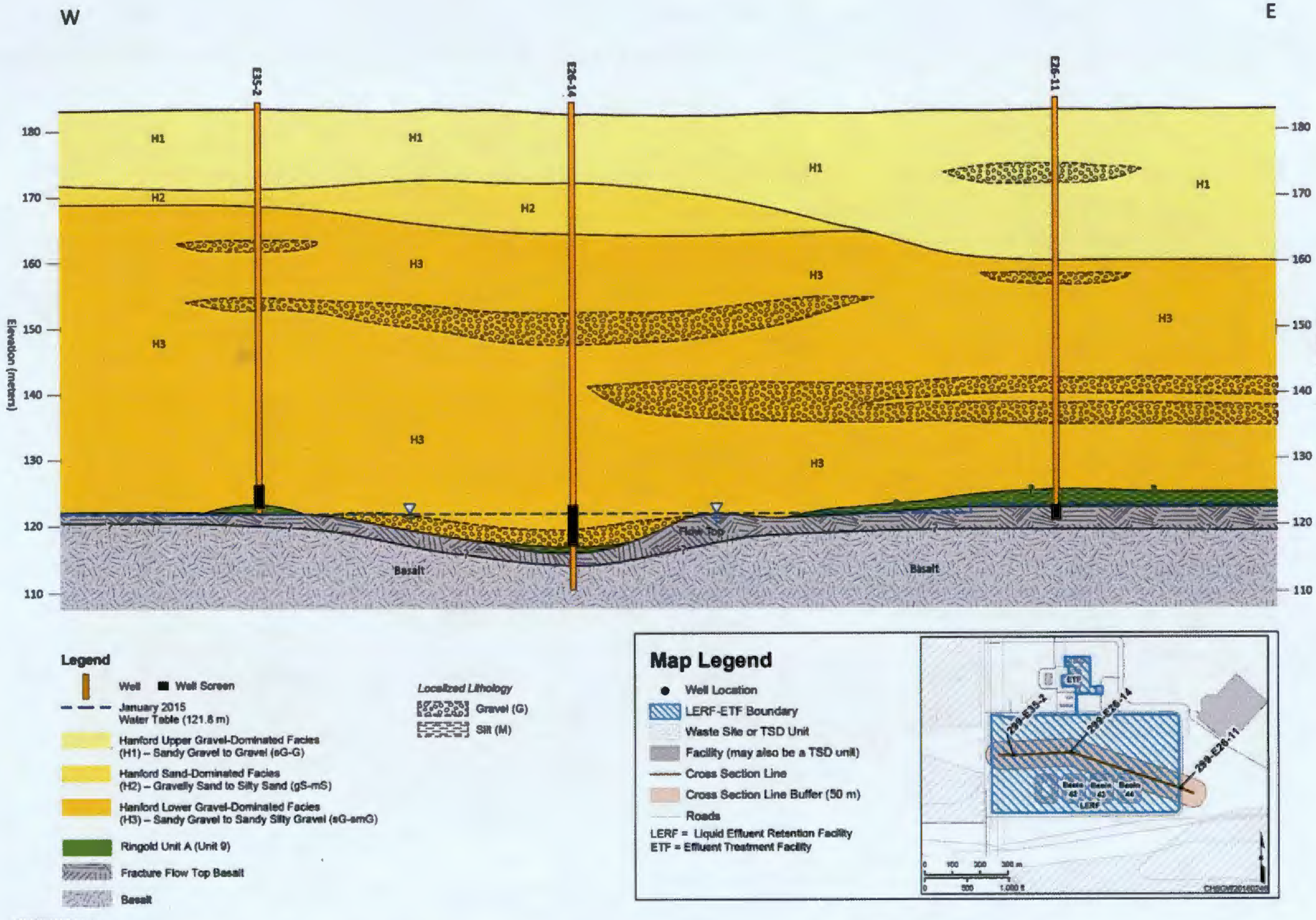


Note: Elevation is from NAVD88, *North American Vertical Datum of 1988*.

Figure D-11. Geology Cross Section Along South Side of LERF



Note: Elevation is from NAVD88, *North American Vertical Datum of 1988.*

Figure D-12. Geology Cross Section Along North Side of LERF

D.2.4.2 Hydrogeology

The thickness of suprabasalt sediments beneath the LERF basins ranges from 60 to 69 m (198 to 225 ft). The vadose zone comprises unconsolidated to weakly cemented, muddy sandy, pebble-cobble gravels to gravelly sand, with occasional layers of sand and/or muddy sand. The gravel content is generally about 60 percent, consisting of 40 to 70 percent mafics. Significantly more cobbles were described in the north and south boreholes than to the east and west of the LERF basins. The only low permeability sediments beneath LERF are the Ringold sediments that are generally located beneath the water table and overlie the basalt surface where present. Some Ringold sediments are present to the east of the LERF Basins above the water table but showed no perched water conditions.

The uppermost aquifer directly beneath LERF is thin to moderate in thickness (e.g., ranging from possibly not present to greater than 8 m [26.25 ft]) and exists in the Hanford and EMB flow top (Figures D-11 and D). The basalt flow top fracturing, brecciation, and/or weathering provide localized zones of higher permeability. Where these conditions exist and are in hydraulic communication with overlying saturated sediments, the basalt flow top is part of the overlying unconfined aquifer system. Based on evaluations of drill cuttings, drilling rates, water production noted during drilling wells 299-E26-77 and 299-E26-79, and geophysical investigations, the EMB flow top functions as a component of the unconfined aquifer as depicted in Figure D-6. The unconfined aquifer extends to the east of LERF and just west of well 299-E26-11, where barometric analyses indicate semiconfined conditions. This determination is consistent with the rise in groundwater elevation when drilling advanced through the lower Ringold sediments, present at this well, causing the groundwater elevation to rise nearly 3.1 m (10 ft) in the temporary casing (WHC-MR-0235). The westward extent of the Ringold sediments is uncertain; however, it has been portrayed to pinch out west of well 299-E26-11 and east of wells 299-E26-14 and 299-E26-15 (Figures D-11 and D-12). Although well 299-E26-11 is still capable of yielding water samples, it continues to differ from the other LERF wells by the nearly meter higher water table elevation (Figure D-13) and the elevated tritium levels characteristic of groundwater influenced by past cooling water discharges at the 216-B-3 Pond (Figure D-14). Therefore, well 299-E26-11 is not included in the LERF groundwater monitoring network.

Well construction details are presented in Table D-4. To date, eight wells have been installed for detection monitoring at LERF. Three of the wells (299-E26-11, 299-E26-77, and 299-E26-79) were screened either entirely or primarily within the EMB flow top. The wells produce 22.7 L/min (6 gal/min) at a minimum, which is sufficient for groundwater sampling, and the flow top is sufficiently permeable for adequate hydraulic connection with the overlying sediments at wells 299-E26-77 and 299-E26-79. Well 299-E26-11 is not characteristic of the unconfined aquifer, is cross gradient of LERF, and is no longer used for monitoring at LERF. Two of the wells have gone dry (299-E26-9 and 299-E35-2), and the final three (299-E26-10, 299-E26-14, and 299-E26-15) are screened only or primarily in the suprabasalt sediments.

Hydraulic tests were conducted in 1990, 2003, 2008, 2011, and 2016 to derive hydraulic parameters for the various saturated formations beneath the LERF general vicinity. Slug tests were completed for each of the eight wells drilled near LERF providing data to derive hydraulic conductivity values (Table D-4). The 1990 slug tests were completed in wells 299-E26-9, 299-E26-10, 299-E26-11, and 299-E35-2. The following paragraphs summarize the results for each well, and WHC-SD-EN-EV-024 provides further detailed discussion. Also, in 2003 hydraulic tests were completed at wells 299-E26-10 and 299-E26-11 and consisted of slug tests at both wells and the following additional tests at well 299-E26-10: tracer test, tracer-pumpback test, and constant rate pumping test. A summary of the results for both wells is provided in this subsection, and PNNL-14804, *Results of Detailed Hydrologic Characterization Tests Fiscal Year 2003*, provides further discussion. Again in 2008, hydraulic slug tests were completed at wells 299-E26-77 and 299-E26-79 (Table D-4). A slug test at well 299-E26-11 also was included in 2008.

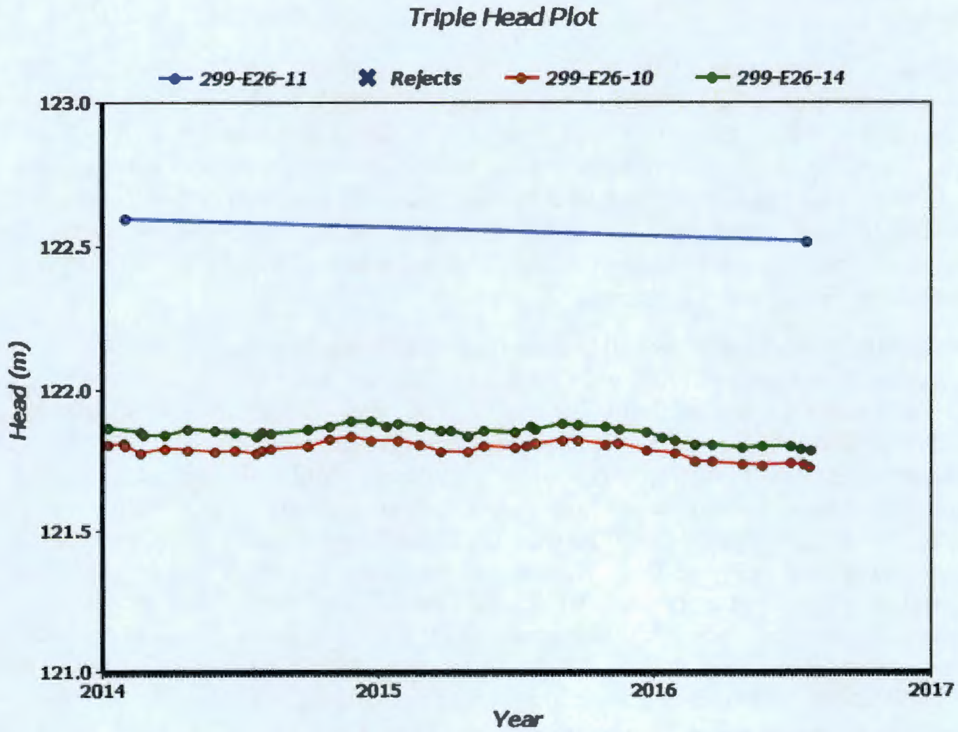


Figure D-13. Comparison of Groundwater Levels to the East, West, and North of LERF at Wells 299-E26-11, 299-E26-10 and 299-E26-14, Respectively

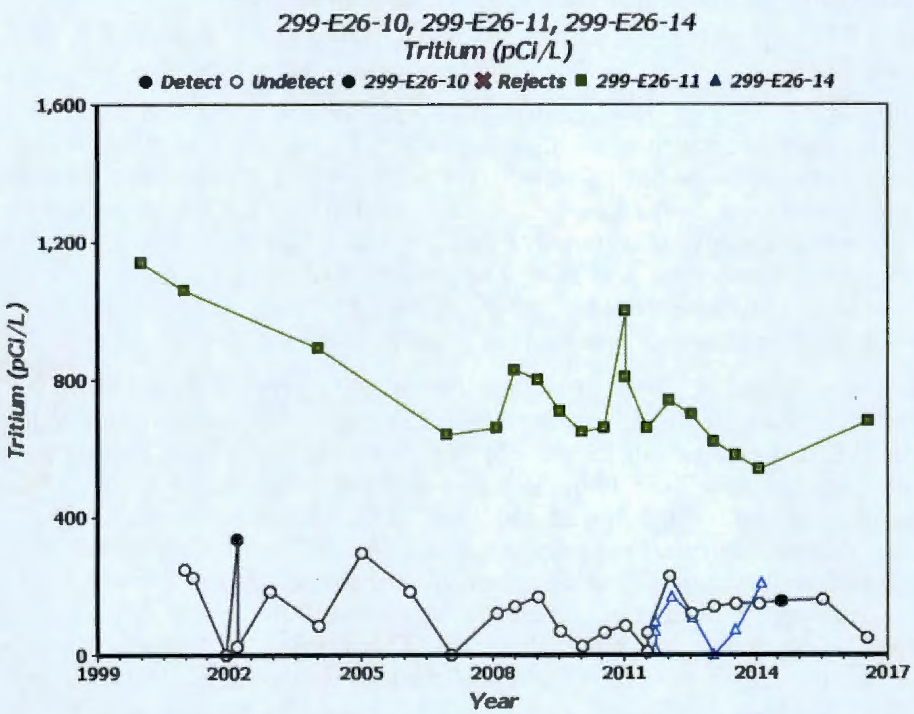


Figure D-14. Comparison of Tritium Levels to the East, West, and North of LERF at Wells 299-E26-11, 299-E26-10 and 299-E26-14, Respectively

This subsection summarizes the 2008 results for each well, and SGW-41072, Rev. 0, provides further discussion. A 2011 constant rate pumping test was completed at well 299-E26-14 (Table D-4). Finally, a constant rate pumping test and slug test were completed in 2016 at well 299-E26-15 (Table D-4). Because several of the well screens cross various formations, a summary of the screen interval is provided in the following text and in Table D-4. When heterogeneous conditions exist, the hydraulic results are an arithmetic average of the individual formational layers based on a weighted thickness (PNNL-14804).

Well 299-E26-9 (now sample dry) was screened only in the Hanford formation. The 1990 slug test derived transmissivity values for well 299-E26-9 ranged from 11 to 230 m^2/day (118 to 2,476 ft^2/day). The derived hydraulic conductivity ranged between approximately 6 to 120 m/day (20 to 394 ft/day), assuming an aquifer thickness of 2 m (6.6 ft).

Well 299-E26-10 is screened primarily in the Hanford formation with a small section in the EMB flow top (0.5 m [1.6 ft]). Transmissivity values for well 299-E26-10 were not derived for the 1990 tests because of the fast recovery response (e.g., less than 3 seconds). In 2003, four hydraulic slug tests (two low and two high stress) were performed at well 299-E26-10. The results produced a hydraulic conductivity range, based on the Kansas Geological Survey (KGS) type-curve method, of 36.7 to 42.8 m/day (120.4 to 140.4 ft/day) for both stress level tests (KGS, 1991, *Seismic Reflection Processing Demonstration Using Eavesdropper*). The KGS type-curve method was used to derive hydraulic conductivity as explained in PNNL-14804. The 2003 screened thickness in the saturated Hanford formation was 1.48 m (4.85 ft). Four additional hydraulic tests were completed at this well in 2003. The tracer-dilution test provided qualitative evidence that the overlying Hanford formation sediments had a considerably higher hydraulic conductivity than the EMB flow top. The tracer-pumpback test was used to derive the effective porosity; however, due to test complexities, the calculation did not appear representative of aquifer conditions. The constant rate pumping test provided another means of deriving hydraulic conductivity, which was reported at 36.2 m/day with a transmissivity of 71.6 m^2/day. Based on the consistency of the 2003 results, hydraulic conductivity ranges between 36.2 and 42.8 m/day.

Well 299-E26-11 is screened only in the EMB flow top. The 1990 derived transmissivity value for well 299-E26-11 was 20.1 m^2/day (216.4 ft^2/d) with a hydraulic conductivity of 11.2 m/day (36.7 ft/day). Five additional hydraulic slug tests were completed at well 299-E26-11 in 2003, which derived a range of hydraulic conductivity values from 5.85 to 6.8 m/day. Four additional slug tests, performed in 2008, produced a reported hydraulic conductivity value of 10 m/day. Hydraulic conductivity values for the three times range from 5.85 to 11.2 m/day. Because of the analysis methods used by PNNL-14804, the most representative value appears to be 6.3 m/day.

Well 299-E26-14 was completed in 2011 with 5.5 m (18 ft) of screen in the Ringold and Hanford sediments. Only a small portion (0.27 m or 0.9 ft) of the Ringold sediments are adjacent the bottom of the well screen. A 103.3 L/min (27.3 gal/min) constant pump test was completed on November 26, 2011. A transducer was installed to collect changing water table elevations during the 75-minute pumping test, in which 2,048 gal were pumped, as described in the field activity log. Because no hydraulic parameters were calculated from the field activity records, type-curve matching methods were used to derive transmissivity and hydraulic conductivity results for this well. The computer program AQTESOLV[21] was used for curve matching. AQTESOLV uses a nonlinear least squares procedure to match a type-curve or straight-line solution for the data provided. Through a sequence of iterations, the procedure systematically adjusts the values of hydraulic properties to achieve the best statistical match between a solution (type-curve) and the test data. Each iteration seeks to minimize the sum of squared residuals. AQTESOLV provides five different solution methods for unconfined aquifer pumping tests. Initially, the Theis and Cooper-Jacob methods were evaluated against the field data, but the curve matching associated with these solution methods did not align (Theis, 1935, "The Relation Between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Ground-Water Storage;"

[21] AQTESOLV is copyrighted by HydroSOLVE, Inc., Reston, Virginia

Cooper and Jacob, 1946, "A Generalized Graphical Method of Evaluating Formation Constants and Summarizing Well-Field History"). The Moench method provides independent parameters for wellbore storage, wellbore skin, and delayed gravity response in anisotropic unconfined aquifers (Moench, 1997, "Flow to a well of finite diameter in a homogeneous, anisotropic water table aquifer"). After manual manipulation of the independent parameter for the wellbore skin factor and delayed drainage parameter, the Moench derived curve nearly matched the field results as provided in Figure D-15. The derived hydraulic conductivity from this curve matching solution was 27.3 m/day. Another solution method (Neuman, 1974, "Effect of Partial Penetration on Flow in Unconfined Aquifers Considering Delayed Gravity Response"), with less independent parameters for manipulation, produced the type-curve in Figure D-16. The derived hydraulic conductivity from this curve matching solution was 24.4 m/day. These results agree with the slug results derived for the other wells in the LERF vicinity. The best estimate is considered 27.3 m/day.

Well 299-E26-15 was completed in 2015 with 1.84 m (6 ft) of screen in the saturated silty sandy gravel of the Hanford formation. The June 16, 2015, well development data and April 28, 2016, slug test injection results were used for type-curve and straight-line matching methods to derive hydraulic conductivity at this well location. During well development, an average pumping rate of 26 L/min (6.7 gal/min) was employed for 45 minutes to remove sediments from the sand pack until lower than 5 nephelometric turbidity unit levels were established. As described in the field activity log, 302 gal were pumped during development.

A Levelogger® transducer was installed in the well to evaluate drawdown during development. This information was input into the type-curve matching methods used to derive transmissivity and hydraulic conductivity in the computer program AQTESOLV. The automated matching option was applied to the Neuman, Moench, KGS, and Springer-Gelhar methods (Springer and Gelhar, 1991, "Characterization of Large-Scale Aquifer Heterogeneity in Glacial Outwash by Analysis of Slug Tests with Oscillatory Responses, Cape Cod, Massachusetts"). The most comparable pumping test derived curve was the Moench method (Figure D-17). This method matched the drawdown results from 10 to 1,000 seconds, or over 2 log time scales. Derived hydraulic conductivity was 102 m/day, which is comparable with the other wells in this area. During the slug test, a 7.6 cm (3 in.) diameter by 1.5 m (5 ft) long slug rod was used to create a falling head slug test. A Levelogger transducer was installed in the well to evaluate the falling head during the slug test. Straight-line and curve matching options were applied using the computer program AQTESOLV. The Bouwer-Rice, 1976, "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells;" Hvorslev, 1951, *Time Lag and Soil Permeability in Ground-Water Observations*; Springer-Gelhar; and KGS single well methods were applied to derive the transmissivity and hydraulic conductivity of the aquifer. Straight-line methods for Bouwer-Rice and Hvorslev were applied only to the falling head portion of the slug test, which occurred between 1.9 and 3.12 seconds into the test. The result of the analysis is a hydraulic conductivity ranging between 60 and 121 m/day. Curve matching methods using the Springer-Gelhar and KGS single well methods were not capable of producing similar curves for the later part of the test. This appears to be influenced by the sand pack around the well screen. Matching the early part of the curve produced similar results to the drawdown test. Thus, the best estimate of hydraulic conductivity for well 299-E26-15 is 102 m/day.

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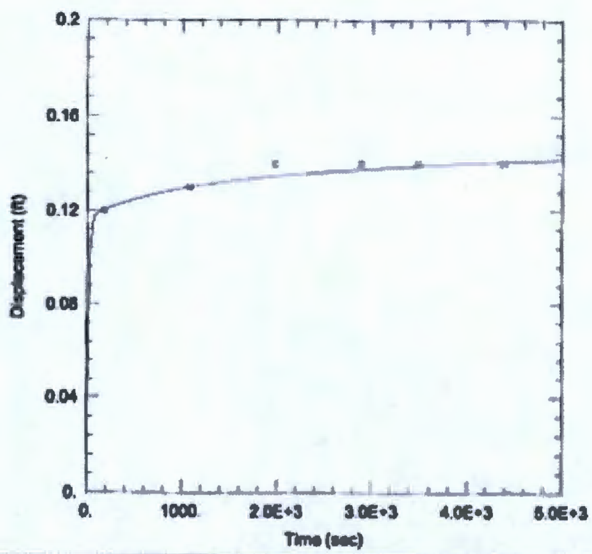


WELL TEST ANALYSIS

Data Set: C:\Documents and Settings\h0091818\My Documents\E26-79\E26-79-2\E26-14.aqt
Date: 07/26/13 Time: 20:03:41

PROJECT INFORMATION

Company: CH2MHill
Client: DOE
Location: LERF
Test Well: 299-E26-14
Test Date: 9-27-2011

AQUIFER DATA

Saturated Thickness: 18. ft Anisotropy Ratio (Kz/Kr): 1.109E+4

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
299-E26-14	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ 299-E26-14	0	0

SOLUTION

Aquifer Model: Unconfined

T = 56.97 cm^2/sec
Sy = 0.001
Sw = 0.6
r(c) = 0.5063 ft

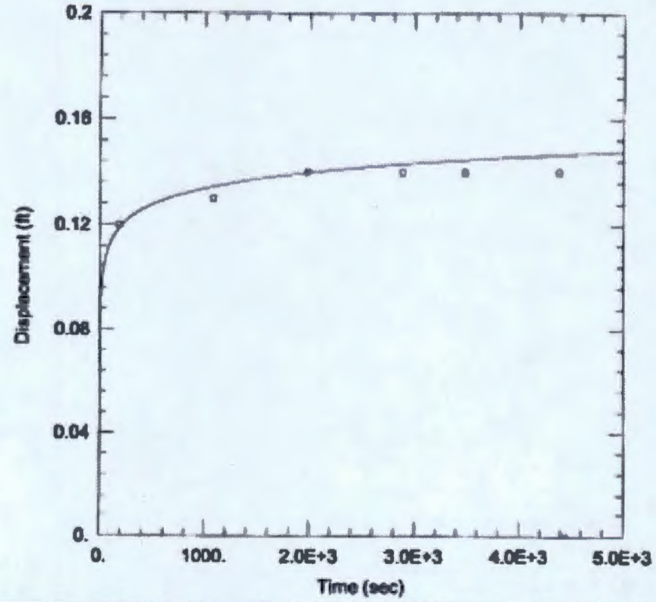
Solution Method: Moench

S = 1.109E-10
ß = 1.023
r(w) = 0.167 ft
alpha = 0.002512 sec^{-1}

α = empirical constant (fitting parameter, early part of curve matching) for noninstantaneous drainage
β = empirical constant (fitting parameter, late part of curve matching)
Kz = vertical hydraulic conductivity
Kr = horizontal hydraulic conductivity
T = transmissivity
S = storativity
Sy = specific conductance
Sw = wellbore skin factor
r(c) = casing radius
r(w) = well radius

Note: Figure is from DOE/RL-2013-46, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility* (Rev. 0).

Figure D-15. AQTESOLV Moench Unconfined Aquifer Pumping/Recovery Test for Type-Curve Match to Well 299-E26-14 with Wellbore Skin Affects and Delayed Gravity Response



WELL TEST ANALYSIS

Data Set: C:\Documents and Settings\h0091818\My Documents\E26-79\E26-79-2\E26-14.aqt
Date: 07/26/13 Time: 22:12:52

PROJECT INFORMATION

Company: CH2MHill
Client: DOE
Location: LERF
Test Well: 299-E26-14
Test Date: 9-27-2011

AQUIFER DATA

Saturated Thickness: 18. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
299-E26-14	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ 299-E26-14	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 50.78 cm^2/sec
S = 1.109E-10
Sy = 0.001
ß = 1.023

T = transmissivity S = storativity
β = empirical constant (fitting parameter, late part of curve matching)
Sy = specific conductance

Note: Figure is from DOE/RL-2013-46, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility* (Rev. 0).

Figure D-16. AQTESOLV Neuman Unconfined Aquifer Pumping/Recovery Test for Type-Curve Match to Well 299-E26-14 with Delayed Gravity Response

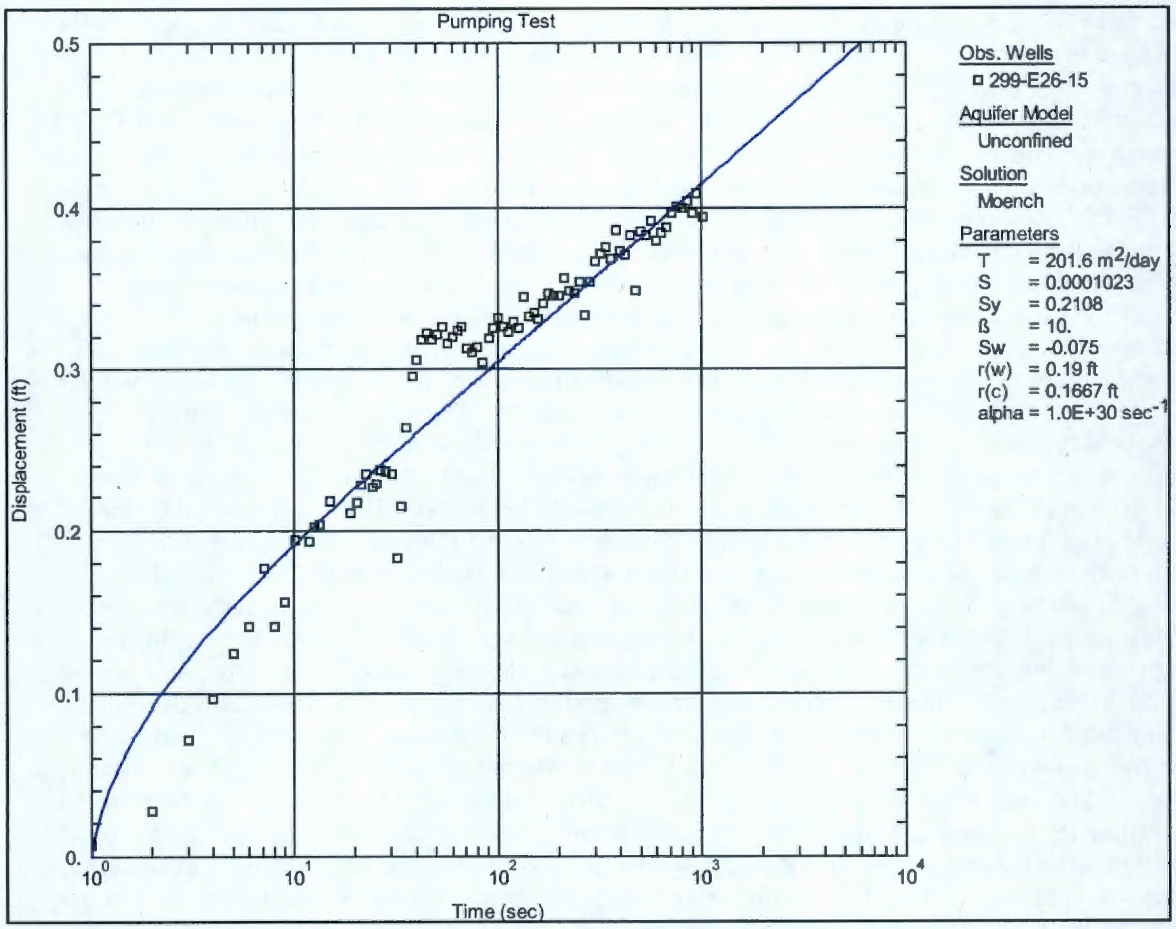
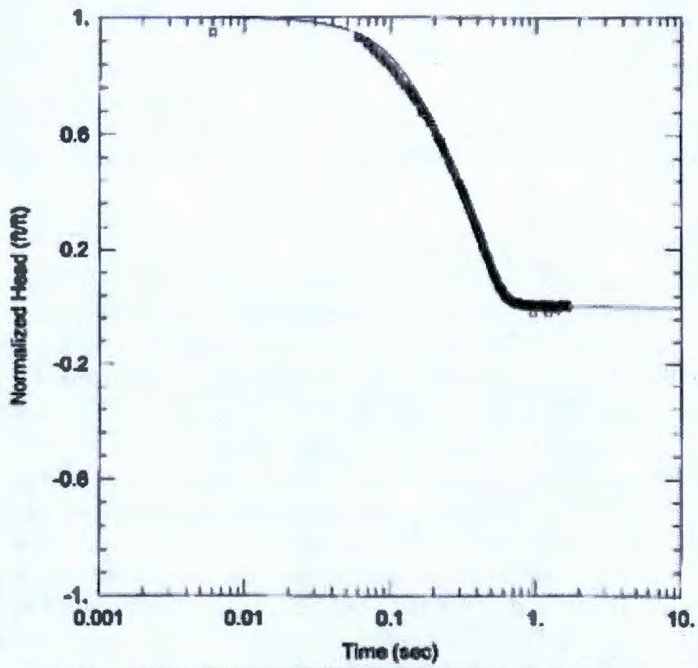


Figure D-17. AQTESOLV Moench Unconfined Aquifer Pumping Test for Type-Curve Match to Well 299-E26-15

Well 299-E26-77 was completed in 2008 with 6.1 m (20.1 ft) of screen in the EMB flow top and 0.71 m (2.3 ft) in the overlying silty sandy gravel Hanford formation. The 2008 derived hydraulic conductivity was reported in SGW-41072, Rev. 0, at several tens of m/day. Because there were no specific values presented in this report, data from the two slug withdraw tests were retrieved and reanalyzed with type-curve methods. Briefly, the type-curve method is useful for analyzing unconfined aquifer conditions because it uses all or any part of the slug test response. As discussed, the computer program AQTESOLV was used for curve matching. The automated matching option with default setting was applied to the KGS model, KGS model with skin effects, and Springer-Gelhar inertial effects method. The most comparable slug test derived curve was the Springer-Gelhar critically dampened method. This method nearly matched the second slug withdraw results, as shown in Figure D-18. One of the assumptions for this type-curve is a quasi steady-state of the aquifer. A quasi steady-state flow neglects specific storage unlike the Cooper-Bredehoeft-Papadopulos method (Cooper et al., 1967, "Response of a Finite-Diameter Well to an Instantaneous Charge of Water"). When the Cooper-Bredehoeft-Papadopulos method was utilized, it did not converge with the test data, indicating that aquifer conditions are more suitable for the Springer-Gelhar method. The Barker-Black fractured aquifer solution method also failed to converge (Barker and Black, 1983, "Slug Tests in Fissured Aquifers"). The Springer-Gelhar results derived a hydraulic conductivity of 134 m/day. For comparison, three additional methods (Bouwer-Rice, Hvorslev, and Barker-Black double porosity fractured aquifer methods) were also analyzed; however, the curve-type matching alignment with the data was either significantly different and did not converge or only visually applied to the later recovering slug test results using line matching which produced much greater hydraulic conductivity results. As discussed in PNNL-14804, the semiempirical nature of the Bouwer and Rice method for complex well/aquifer conditions can lead to declining levels of accuracy beyond thirty percent. Thus, the best estimate of hydraulic conductivity for well 299-E26-77 is 134 m/day using the Springer-Gelhar solution. Because hydraulic conductivity results from other tests in the area produce much lower results for the Hanford formation, the fractured flow top appears to be the dominate flow regime at this well. If the fractured flow top is thinner and the borehole diameter within the basalt is smaller, the hydraulic conductivity value would be even higher. Conversely, if the flow top is thicker and the borehole diameter is larger, the hydraulic conductivity value would be smaller.

Well 299-E26-79 was completed in 2008 with 4 m (13.2 ft) of screen in the EMB flow top and 2.7 m (8.9 ft) in the overlying Ringold and Hanford sediments. The 2008 derived hydraulic conductivity was reported in SGW-41072, Rev. 0, at several tens of m/day. Because there were no specific values presented in this report, the two slug withdraw tests were retrieved and reanalyzed with type-curve methods, as discussed for well 299-E26-77. Earlier slug test data were not able to be fit by any of the AQTESOLV solution methods. Fitting the remaining portion of the data produced significantly larger hydraulic conductivity results by one to two orders of magnitude than at well 299-E26-77. Because the results are not validated with AQTESOLV or the other LERF well results, the data do not appear to be useable; therefore, no hydraulic conductivity results were generated for this well.

Well 299-E35-2 (now sample dry) was screened mainly in the sediments above the EMB flow top (1.9 m) with a portion of the screen in the EMB flow top (0.4 m). Using an aquifer thickness of 0.9 m (3 ft), the 1990 derived transmissivity value for well 299-E35-2 was 35.7 m^2/day (385 ft^2/day) with a hydraulic conductivity of 39.7 m/day (130 ft/day).



WELL TEST ANALYSIS

Data Set:
Date: 07/26/13 Time: 11:38:17

PROJECT INFORMATION

Company: CH2MHill
Client: DOE
Location: LERF
Test Well: 299-E26-77
Test Date: 11-18-2008

AQUIFER DATA

Saturated Thickness: 24.15 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (299-E26-77-2)

Initial Displacement: 3.347 ft
Total Well Penetration Depth: 24.15 ft
Casing Radius: 0.167 ft

Static Water Column Height: 24.15 ft
Screen Length: 24.15 ft
Well Radius: 0.833 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Springer-Gelhar
K = 0.1549 cm/sec Le = 0.8248 ft

K = Hydraulic conductivity
Le = Effective water column length

Note: Figure is from DOE/RL-2013-46, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility* (Rev. 0).

Figure D-18. AQTESOLV Springer-Gelhar Critically Dampened Type-Curve Match to Well 299-E26-77

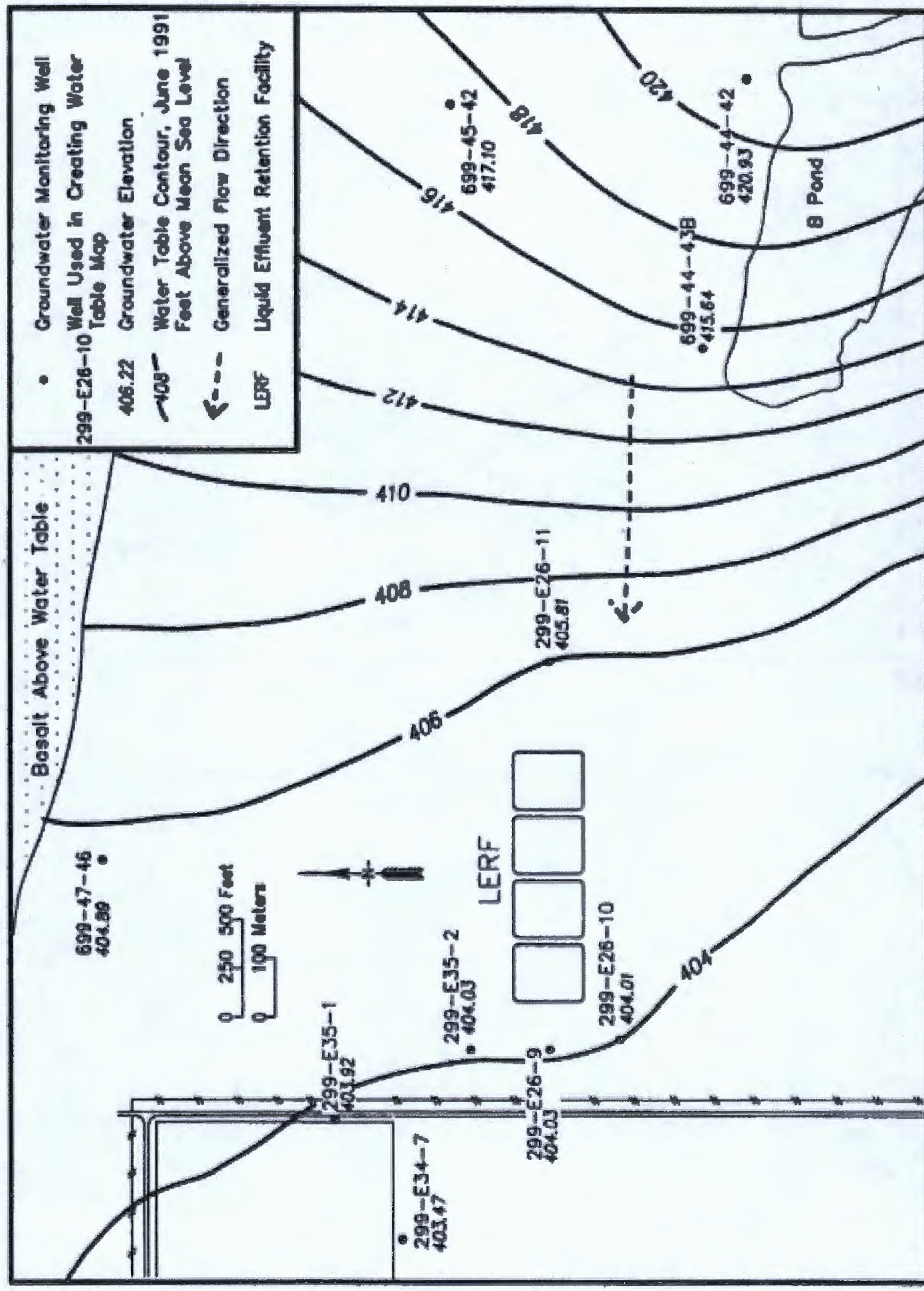
In summary, the multiple slug test and pumping test results at seven of the eight wells described adequately define hydraulic conductivity for the basalt flow top and Hanford sediments. The basalt flow top slug test data produced varying results of hydraulic conductivity. Results were low to the east, while results to the south and west of LERF were significantly greater. Hydraulic conductivity at well 299-E26-15, derived by a pumping test, matched the basalt flow top hydraulic conductivity to the west of LERF. Derived values ranged between 100 and 134 m/day. To the north, slug test results for the overlying suprabasalt sediments produced a lower hydraulic conductivity range of 24.4 to 42.8 m/day. These values appear to confirm the steeper groundwater gradient beneath LERF than in other parts of the 200 East Area.

D.2.4.3 Groundwater Flow Interpretation

Defining groundwater elevations in the 200 East Area has been difficult due to the flat nature of the water table. During early operation, contaminant migration was the primary method for determining groundwater flow within the 200 East Area. Elevation changes across large distances were later used to offset measurement error. In 2005, local low-gradient groundwater monitoring networks were devised, where measurement error was reduced through borehole deviation surveys, precision land surface surveys, barometric pressure corrections, dedicated measurement devices (e.g., e-tapes), and dedicated personnel. Through this evolution of refined measurement methods, groundwater gradients of 10^{-6} m/m have been statistically approached in certain areas. Where these precision methods have been employed, the groundwater well network is fairly large (e.g., scale of kilometers in size). Because of the limited areal extent and only recent evolution of more precise groundwater measurements, past gradient and groundwater flow direction determinations at LERF have not had the level of accuracy as defined since 2012. This summary explains why regulatory variances and alternative monitoring methods at LERF were needed and considered in the past, respectively. The following paragraphs summarize past groundwater flow direction determinations and explains the evolvement of the current monitoring network. Historical changes in the potentiometric surface and flow direction at the Hanford Site (including 200 East Area) are further described in SGW-60338, *Historical Changes in Water Table Elevation and Groundwater Flow Direction at Hanford: 1944 to 2014*.

Prior to the formation of the groundwater mound around the 216-B-3 Pond, the direction of groundwater flow was to the southeast throughout the 200 East Area (DOE/RL-90-43). Regional groundwater flow in the early 1990s was from east to west (DOE/RL-92-03, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1991*), driven by significant cooling water discharges (e.g., >9 × 10^9 L/year) to the 216-B-3 Pond (Figure D-19). The discharges to 216-B-3 Pond and associated lobes diminished during the 1990s and were terminated in 1997, causing water levels in the LERF monitoring network (299-E26-9, 299-E26-10, 299-E26-11, and 299-E35-2) to decline (Figure D-20). In 1996, the groundwater flow direction was still determined as east to west beneath LERF (PNNL-11470, *Hanford Site Groundwater Monitoring for Fiscal Year 1996*); however, the calculation was based on the water table elevation from the semiconfined aquifer at well 299-E26-11 (e.g., assumed upgradient because of higher water table elevation and located east of LERF) to the unconfined aquifer at well 299-E26-9 (downgradient and located to the west of LERF).

Between 1997 and 2001, changing conditions required reevaluation of the flow direction and conceptual model of the aquifer thickness. In 1997, the regional groundwater flow direction was determined as southwest (Figure D-21), while the LERF monitoring well network continued to portray a westward flow direction. In January 2001, well 299-E35-2 was declared dry and limited aquifer thickness in well 299-E26-11 and 299-E26-10, drove the assumption that the unconfined aquifer was disappearing (PNNL-13404, *Hanford Site Groundwater Monitoring for Fiscal Year 2000*). Figure D-22 presents the conceptual model of the remaining aquifer and the basalt above the aquifer at the time.



Note: Figure is from DOE/RL-92-03, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1991.*

Figure D-19. 1991 LERF Groundwater Flow Direction Interpretation

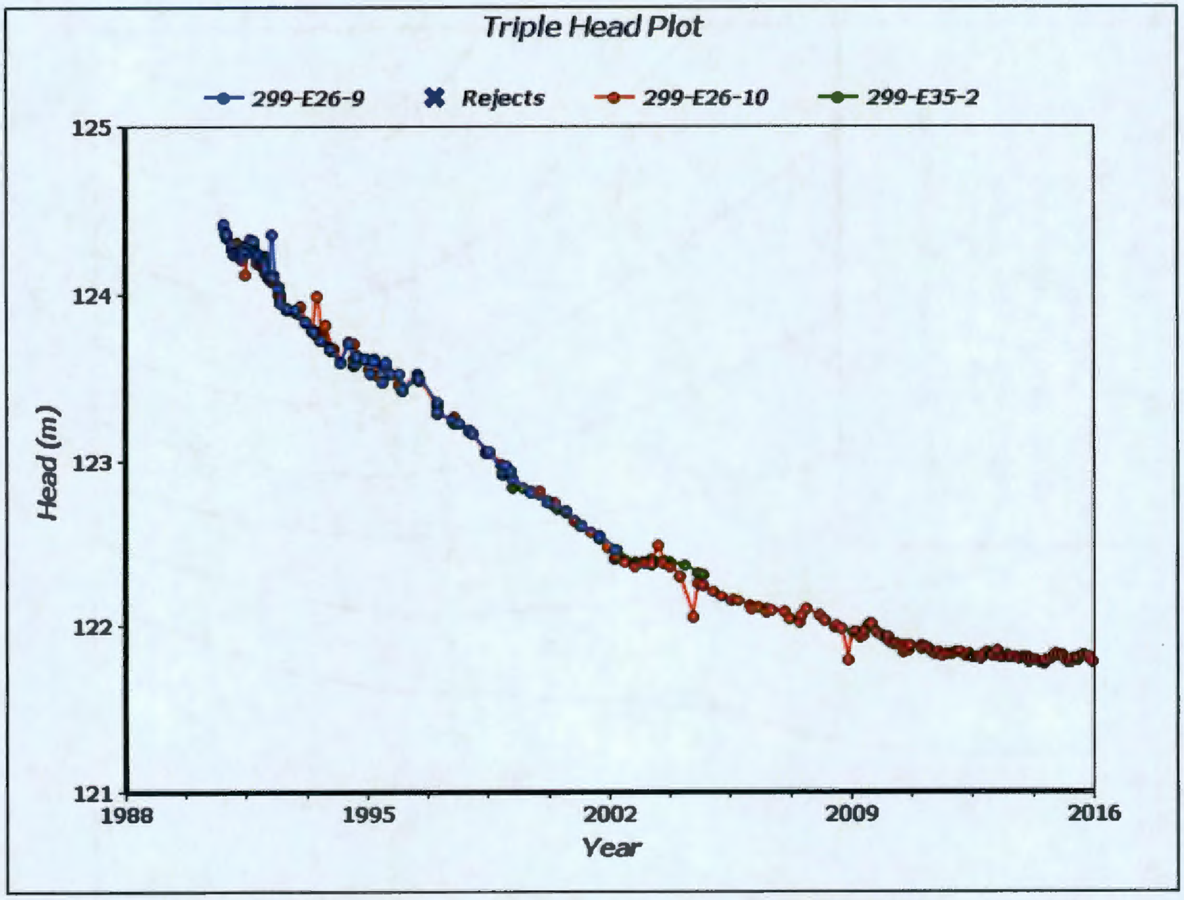
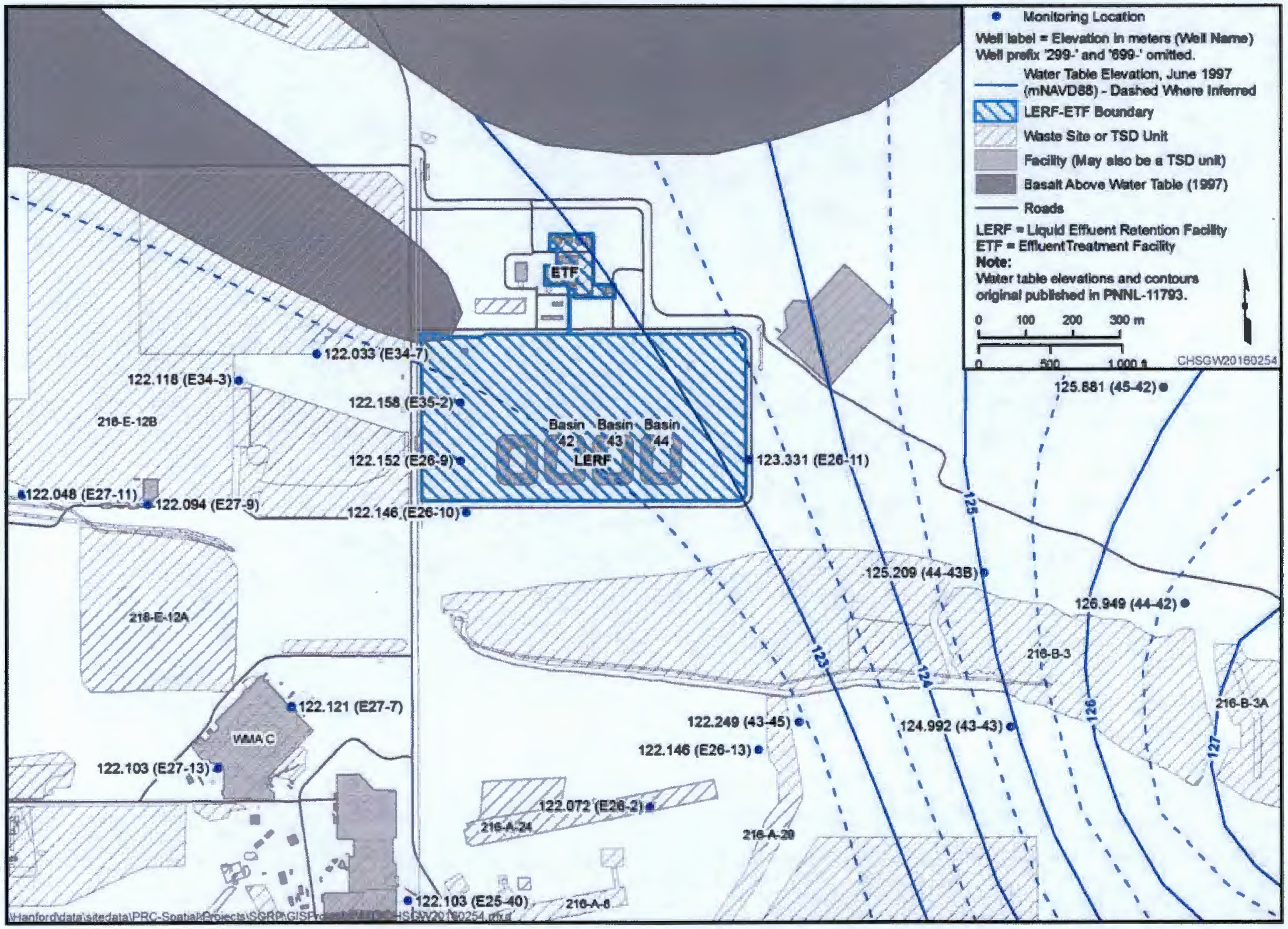


Figure D-20. Water Table Elevation Decline at LERF Monitoring Wells



Note: Figure is from PNNL-11793, *Hanford Site Groundwater Monitoring for Fiscal Year 1997.* Reference: NAVD88, *North American Vertical Datum of 1988.*

Figure D-21. 1997 Regional Groundwater Flow Interpretation

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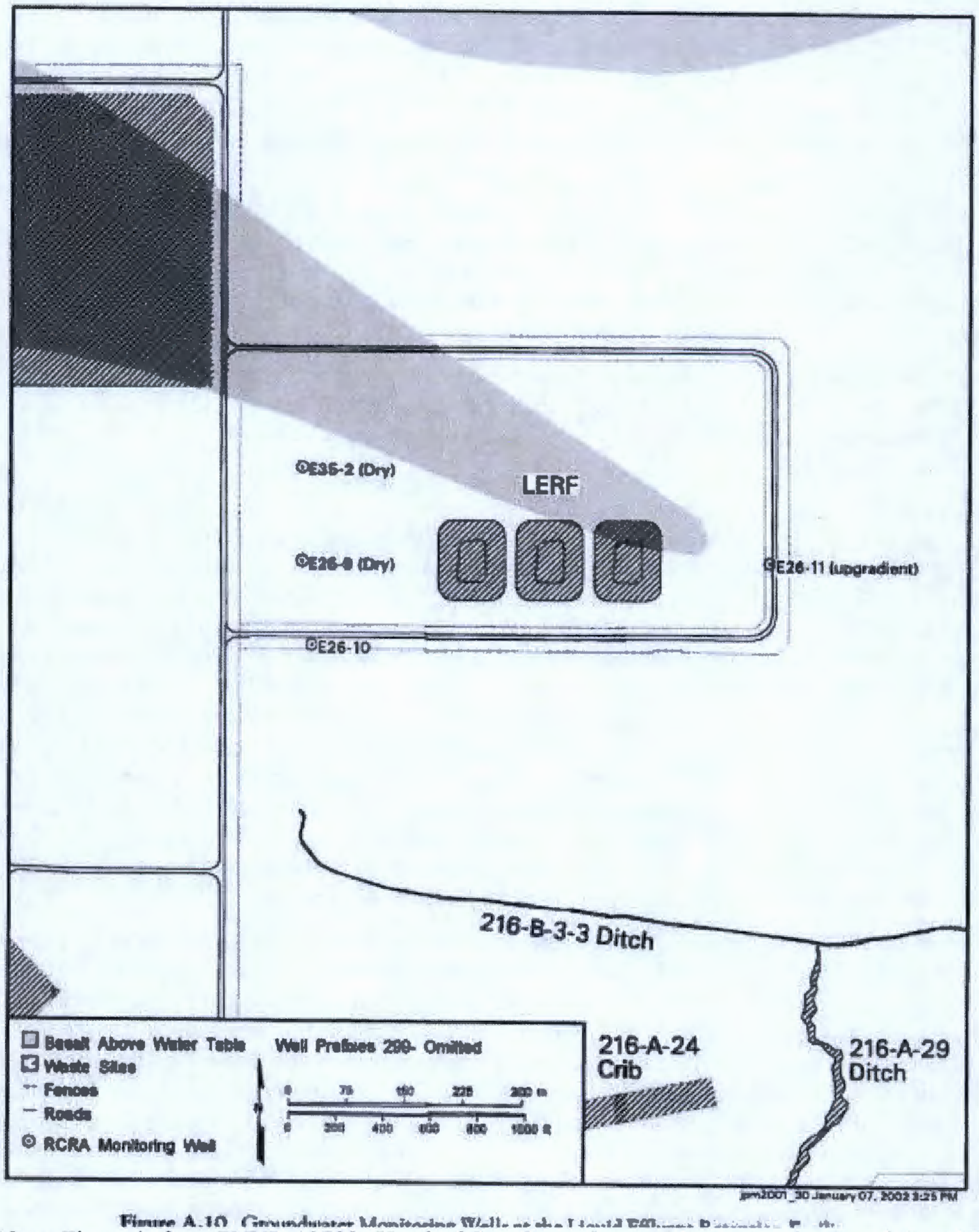


Note: Figure is from PNNL-13788, *Hanford Site Groundwater Monitoring for Fiscal Year 2001.*

Figure D-22. 2001 Basalt Above Aquifer Interpretation

In 2004, Ecology modified Revision 8 of the Hanford Facility RCRA Permit by adding Attachment 34, (WA7890008967, 2004). Attachment 34 called for determining the groundwater flow characteristics of the unconfined aquifer, including an assessment of barometric pressure fluctuations in the LERF monitoring wells and the potential for these fluctuations to affect hydraulic gradient and groundwater flow direction determinations.

In 2007, SGW-35756, directed field work which determined well 299-E26-11 was confined and well 299-E26-10 was unconfined. It was also determined that well 299-E26-11 had a significant effect on the trend-surface analysis because the water level elevation in 299-E26-11 was approximately 1 m higher than the other wells. An important recommendation in SGW-35756 was to correct for barometric effects in the two 2008 proposed LERF wells for a more accurate determination of long-term groundwater flow conditions.

In 2008, DOE/RL-2008-41, drove the installation and hydraulic testing of wells 299-E26-77 and 299-E26-79 (Figure D-23), which found fractured basalt flowtop was hydraulically connected with the suprabasalt unconfined aquifer and had similar hydraulic properties. As a result, two geophysical investigations were initiated in 2010 to define the extent of the suprabasalt and fractured basalt aquifer and thickness.

In 2011, seismic reflection and refraction data along with electromagnetic and resistivity data were collected at LERF. The associated geophysical reports included SGW-52161, SGW-52162, and SGW-52467. This information was used to locate the installation of upgradient LERF well 299-E26-14 and downgradient well 299-E26-15.

Well 299-E26-14 was drilled in September 2011. This well was surveyed as discussed above to reduce measurement error and added to the existing LERF low-gradient groundwater monitoring network (299-E26-10, 299-E26-77, 299-E26-79). The derived flow direction from 2012 to 2013 indicated a nearly south flow direction (Figure D-24). Based on the extent and depth of the suprabasalt aquifer to the south of Basin 43, well 299-E26-15 was proposed in DOE/RL-2013-46 and installed in 2015. Characterization of the basalt at this location was determined not to be required. In May 2016 the corrected low-gradient water level flow direction was determined as south using wells 299-E26-10, 299-E26-14, 299-E26-15, 299-E26-77, and 299-E26-79 (Figure D-2). Figure D-25 provides a comparison of the measured water level trends for upgradient well 299-E26-14 and downgradient wells 299-E26-15 and 299-E26-79. The water levels are comparable for the downgradient wells, while the upgradient well is consistently 5 to 8 cm (2.0 to 3.1 in.) higher. The downgradient well locations also provide coverage of potential leakage into the aquifer from Basin 43 and 44. Historically, groundwater flow direction has not remained uniform within LERF (see DOE/RL-90-43, pg. 5-21). Accordingly, these downgradient wells are appropriately positioned to monitor potential leakages into the aquifer from Basins 42 and 43.

The measurement error associated with the LERF water levels is assumed to be relatively small as several corrections were made to minimize potential sources of measurement error (e.g., adjustments for well casing deviation from vertical, resurveys of well casing elevations, corrections for barometric effects, and accounting for measuring device accuracy). In addition, statistical trend testing (analysis of variance) of the gradient plane derived by individual water level measurements for each of the four LERF water level network wells (299-E26-10, 299-E26-14, 299-E26-77, and 299-E26-79) was completed. More discussion of this method is provided in SGW-54165, *Evaluation of the Unconfined Aquifer Hydraulic Gradient Beneath the 200 East Area, Hanford Site*. Between April 2014 and November 2015 the statistical trend testing ranged between a 55 and 91% confidence level that the derived gradient was true. The average statistical probability of a unique gradient during this time was 72%. The low confirmation by statistical analysis appears to be affected by the small number of wells in the LERF network and the non-uniform hydraulic gradient magnitude at this site (SGW-54165). The non-uniform hydraulic gradient appears to reflect the lower permeable sediments to the north of the LERF basins as discussed in Section D.2.4.2. Though the statistical probability analysis was low, the variation in gradient and groundwater flow direction was very consistent. The groundwater gradient between April 2014 and November 2015 ranged between 1.77×10^{-4} and 2.83×10^{-4} m/m with an average of 2.46×10^{-4} m/m. The flow direction between April 2014 and November 2015 ranged from 3° east of south to 14° west of south. The average groundwater flow direction during the timeframe was 6° west of south.

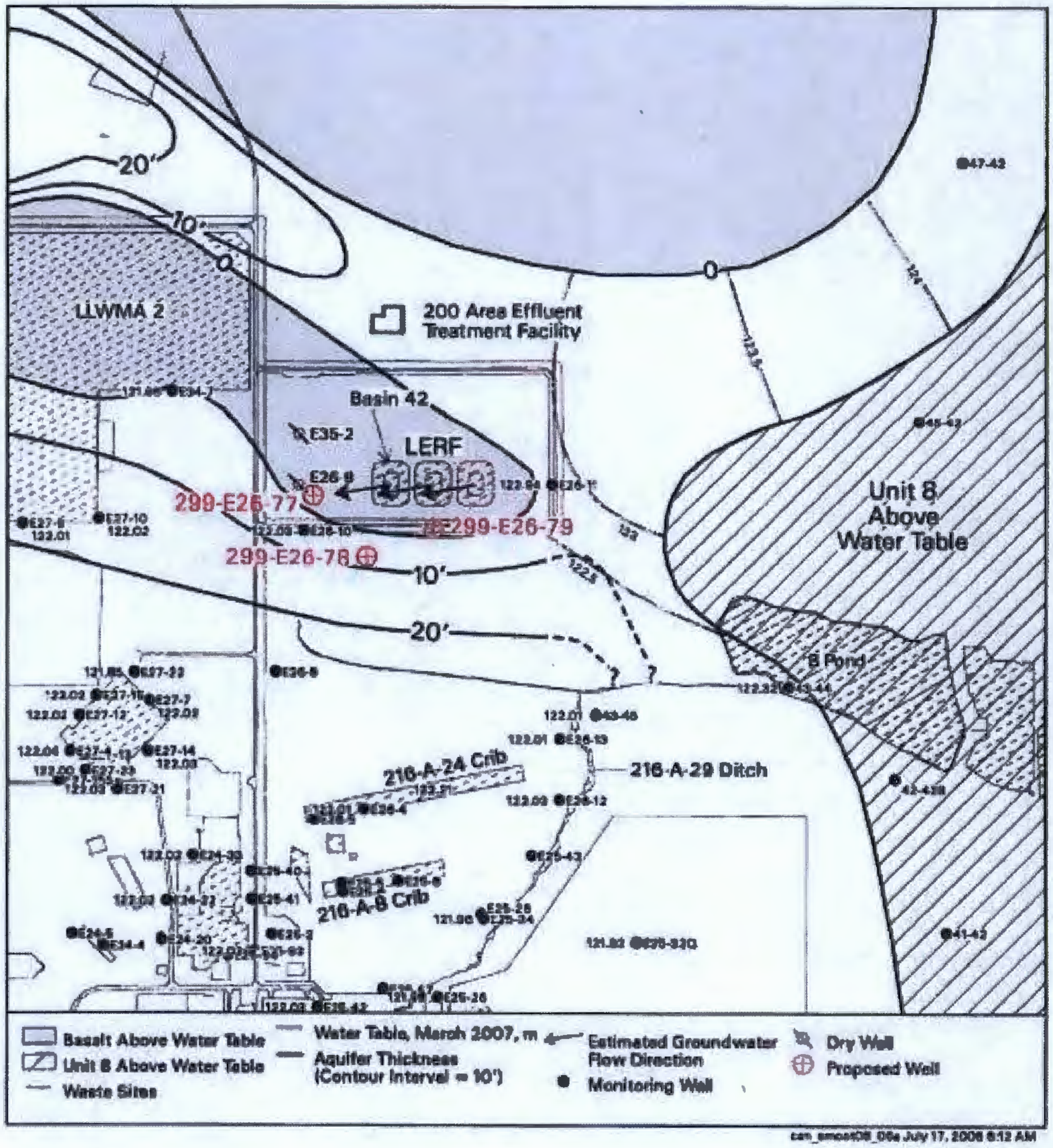
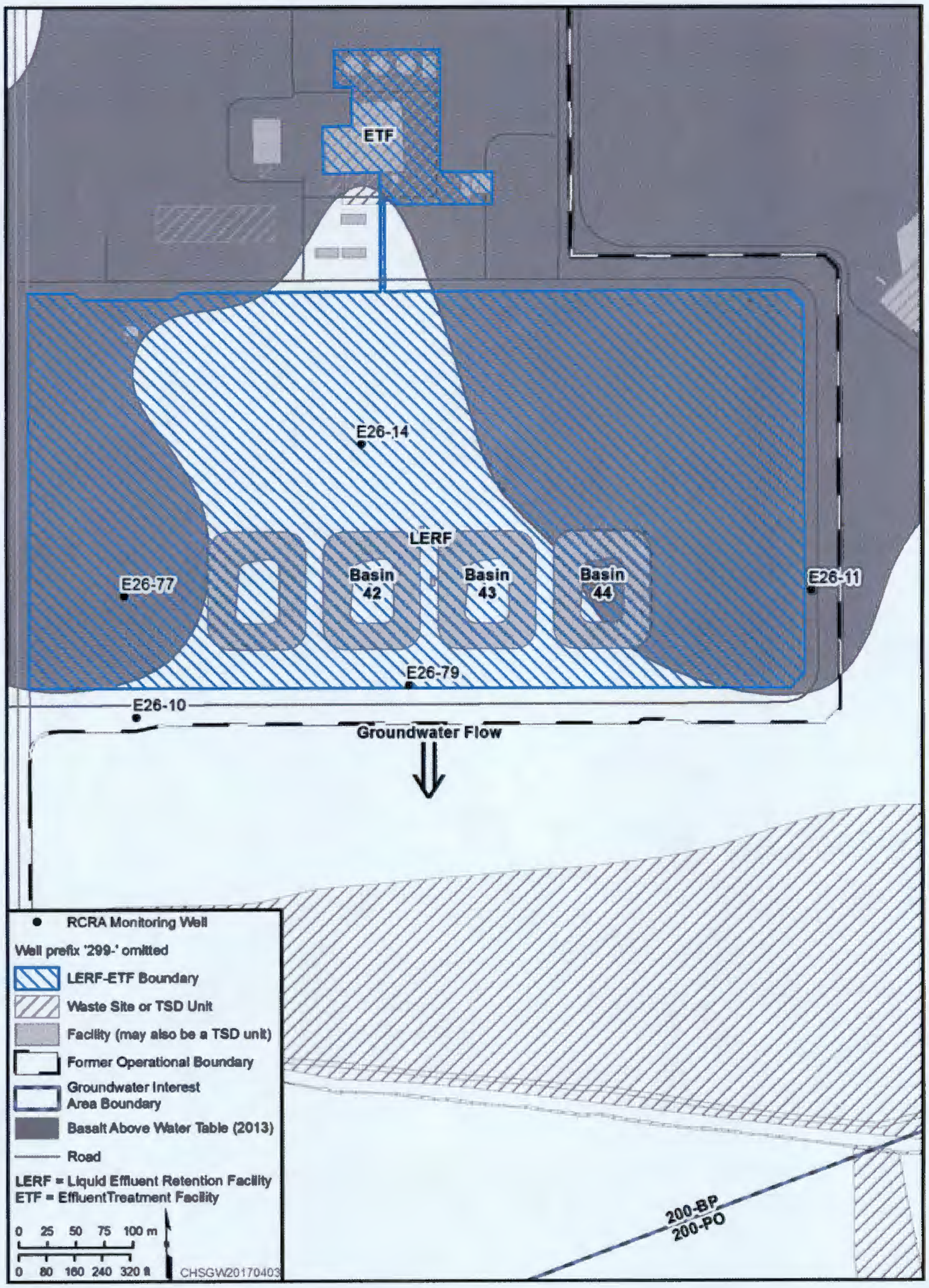


Figure D-23. 2008 Proposed New LERF Well Locations, Estimated Groundwater Flow Direction and Conceptual Model for Basalt Extent Above Water Table



Note: Figure is from DOE/RL-2014-32, *Hanford Site Groundwater Monitoring Report for 2013.*

Figure D-24. 2013 LERF Monitoring Network and Groundwater Flow Direction (Summary of Previous Groundwater Monitoring)

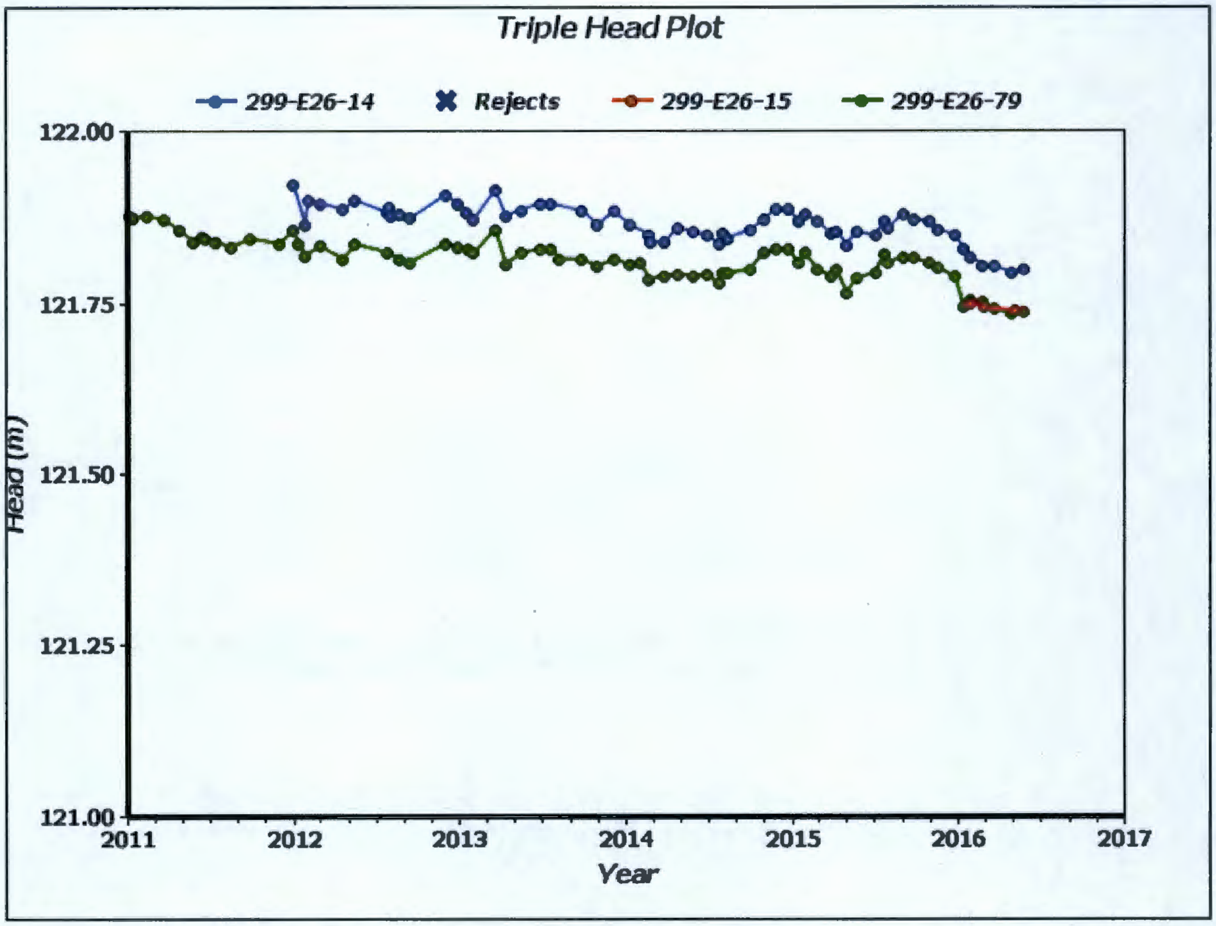


Figure D-25. Water Level Trends for LERF Wells 299-E26-14, 299-E26-15, and 299-E26-79

Figures D-26 and D-27 provide a comparison of TEDF discharge volumes in liters per month versus the average groundwater gradient and average groundwater flow direction determinations beneath LERF, respectively. The LERF water level response from TEDF discharges is similar between wells causing no significant change in gradient. However, the water table at well 299-E26-79 appears to increases a centimeter or two more than the other wells during significant TEDF discharges (>10^7 L/month) and may be the reason for groundwater flow direction changes of up to 10° west of south (Figure D-26).

Flow rates were determined in 2016 in ECF-HANFORD-16-0139, *Hydraulic Gradients and Velocity Calculations for RCRA Sites in 2016*. The ECF documents the methodology, assumptions, and inputs and calculations that result in the following conclusions for LERF: "The hydraulic gradient was determined by trend surface analysis of monthly water level measurements between May and October 2016. Due to the low gradient magnitude in this area, all wells used have been resurveyed for casing elevation and have had gyroscope surveys performed to control for deviation error. The water level data were corrected for barometric effects before performing the calculations. The average hydraulic gradient was 2.79 x 10^{-4} m/m toward the south (183°) and the estimated groundwater flow rate is 0.11 m/d." Additionally, for LERF, data were corrected for barometric effects using the methods of SGW-54165.

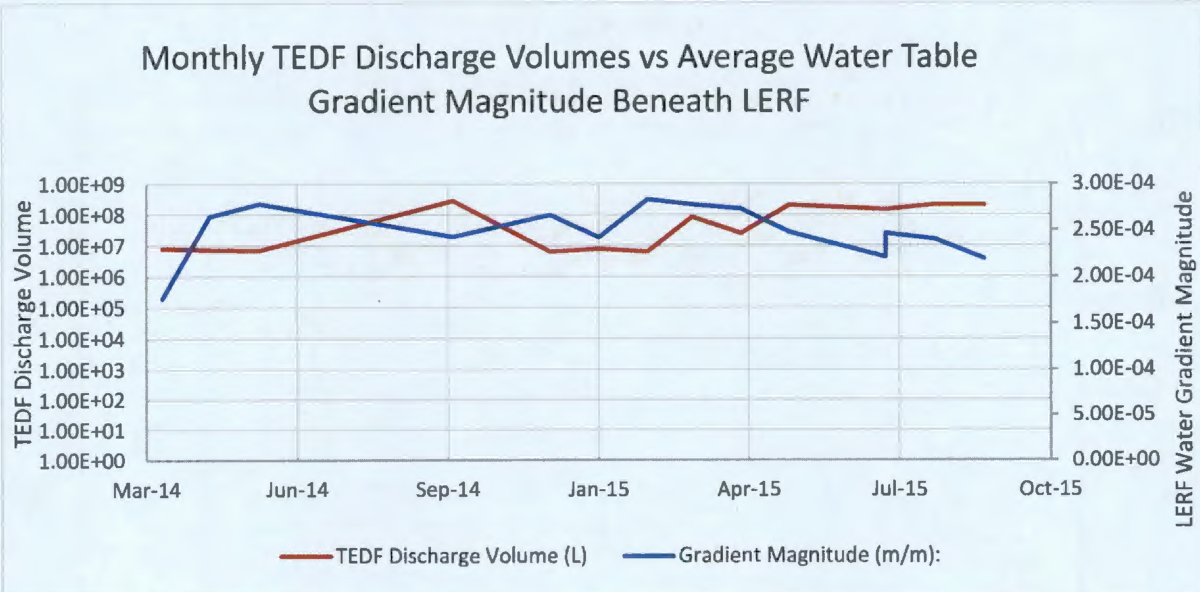


Figure D-26. Monthly TEDF Discharge Volumes (in Liters) versus Average Water Table Gradient Magnitude Beneath LERF

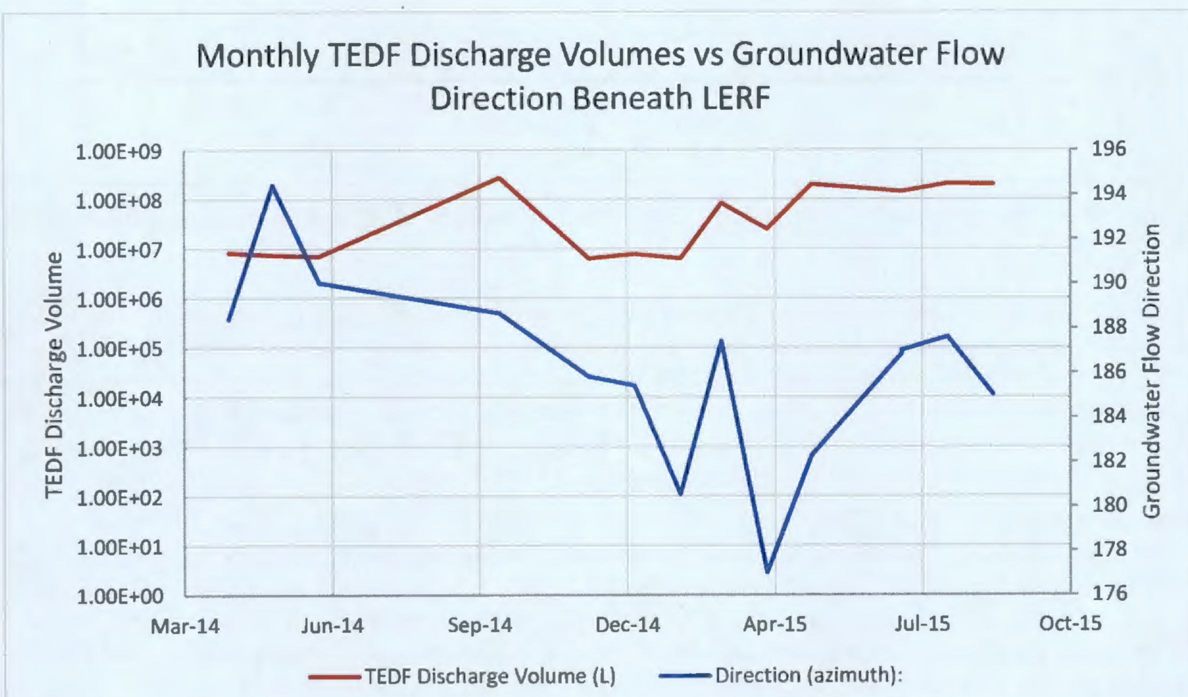


Figure D-27. Monthly TEDF Discharge Volumes (in Liters) versus Average Groundwater Flow Direction Beneath LERF

D.2.5 Summary of Previous Groundwater Monitoring

Table D-5 lists the previous groundwater monitoring plans, change notices, letters of notification, assessment reports, letter of direction, Hanford Facility RCRA Permit changes, and associated reports connected with permit conditions required at LERF. Below is a summary of the groundwater monitoring history associated with LERF.

Under interim status, indicator parameter groundwater monitoring was initiated at LERF in 1990 as described in WHC-SD-EN-AP-024 (Rev. 0). The interim status groundwater monitoring network consisted of one upgradient well (299-E26-11) and three downgradient wells (299-E26-9, 299-E26-10, and 299-E35-2). The groundwater monitoring plan was revised in 1991 (WHC-SD-EN-AP-024, Rev. 1), driven by the addition of site specific parameters aluminum and ammonium.

In 1992, no liquid effluent had been discharged to the facility; however, the four quarters of background monitoring was completed in April of 1992 (DOE/RL-93-09, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1992*). The background analysis included indicator parameters of pH, specific conductance, TOC, and total organic halogen (TOX). Background arithmetic mean and statistically determined significant increases (and decreases, in the case of pH) over initial background were reported for pH, specific conductance, and TOC. Statistical analysis for TOX was not reported as enough data to perform statistical determinations had not yet been collected. The statistical measure for pH was considered to be too large to be meaningful so additional data were required to determine the statistically determined significant increase (critical mean). In addition, a year of quarterly groundwater samples for drinking water parameters were collected which included: metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), anions (fluoride and nitrate), herbicides (endrin, lindane, methoxychlor, toxaphene, 2,4-D, and 2,4,5-TP Silvex), radium, gross alpha, gross beta, turbidity, and coliform bacteria. Only unfiltered chromium and iron were elevated above drinking water standards during the background monitoring. These elevated constituents were identified as being elevated in recently constructed wells. Groundwater quality parameters included chloride, iron, manganese, phenols, sodium, and sulfate. Site specific parameters included ammonia, 1-butanol, and tritium. Also, the shallow aquifer was discussed in relation to the dissipating B Pond mound and one or more of the LERF monitoring wells was forecasted to go dry in the future.

In 1993, well 299-E26-9 was not able to be sampled due to declining water levels and was removed from the sampling schedule (DOE/RL-93-88, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1993*, Section 4.10.4). The well was not sampled again until June 1994 due to low water levels (DOE/RL-94-136, *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1994*, Section 4.8.2). Unfiltered chromium and iron were still elevated above drinking water standards in 1993, which was attributed to well construction. The same constituents were collected and analyzed for drinking water parameters, indicator parameters and groundwater quality parameters. Statistical problems for deriving a critical mean for pH and TOX continued. The site specific parameters changed to gamma scan, tritium, volatile organic analysis, and uranium.

In 1994, another revision was approved, removing initial 40 CFR 265.92 Appendix III parameters and aluminum and adding 1-butanol semiannually and alkalinity annually (ECN 603891).

In 1994, Ecology issued the Hanford Facility RCRA Permit for the Hanford Site, which included the Part II General Facility Condition II.F requiring final status groundwater monitoring requirements (WAC 173-303-645). A final status detection monitoring plan (PNNL-11620), under WAC 173-303-645, was submitted for incorporation with Revision 4 of the Hanford Facility RCRA Permit. Revision 4 was implemented January 28, 1998, incorporating LERF and the 200 Area ETF as final status operating units.

Table D-5. Previous Monitoring Plans and Associated Documents Required to Establish a Final Status Monitoring Plan and Network for LERF

Document	Date Issued	Monitoring Program
WHC-SD-EN-AP-024, *Interim Status Ground Water Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility* (Rev. 0)	1990	Interim Status Indicator Parameter Evaluation Constituents included sampling requirements from 40 CFR 265.92, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Sampling and Analysis." Wells 299-E26-9, 299-E26-10, 299-E26-11, and 299-E35-2 proposed and drilled in 1990.
WHC-SD-EN-AP-024, *Interim Status Ground Water Monitoring Plan for the 200 East Area Liquid Effluent Retention Facility* (Rev. 1)	1991	Interim Status Indicator Parameter Evaluation Updated version provided an update on 242-A Evaporator condensate and modified the parameter list for groundwater monitoring. Constituents monitored included quarterly sampling requirements from 40 CFR 265.92 for first year. Added aluminum and ammonium as site specific parameters. Wells 299-E26-9, 299-E26-10, 299-E26-11, and 299-E35-2 installed. Upgradient Well: 299-E26-11. Downgradient Wells: 299-E26-9, 299-E26-10 and 299-E35-2.
ECN 603891	1994	Removed the 40 CFR 265.92 Appendix III parameters and aluminum after collection, analysis, and review. Maintained the semiannual indicator and annual groundwater quality parameters. Added alkalinity annually and 1-butanol semiannually. Upgradient Well: 299-E26-11. Downgradient Wells: 299-E26-9, 299-E26-10, and 299-E35-2.

Table D-5. Previous Monitoring Plans and Associated Documents Required to Establish a Final Status Monitoring Plan and Network for LERF

Document	Date Issued	Monitoring Program
PNNL-11620, *Liquid Effluent Retention Facility Final-Status Groundwater Monitoring Plan* (Rev. 0)	1997	Monitoring plan prepared for final status.[b] However, until approved by regulators, monitoring activities continued under interim status in compliance with ECN 603891 for WHC-SD-EN-AP-024. Constituents monitored: nitrate, total organic carbon, and total organic halogens. Upgradient Well: 299-E26-11. Downgradient Wells: 299-E26-9, 299-E26-10, and 299-E35-2.
Revision 4 of the Hanford Facility RCRA Permit	1998	Part III, Operating Units LERF and the 200 Area ETF incorporated into Hanford Facility RCRA Permit. However, according to PNNL-12086, *Hanford Site Groundwater Monitoring for Fiscal Year 1998*, and other yearly groundwater monitoring reports through 2000, groundwater monitoring was completed in accordance the interim status groundwater monitoring plan, WHC-SD-EN-AP-024 with ECN 603891 associated changes.
Furman, 1999, "Letter of Notification of Specific Conductance Exceedance at 200 East Area Liquid Effluent Retention Facility"	1999	Letter notifies Ecology that under interim status detection monitoring the average results from the quadruplicate samples collected at wells 299-E26-9 and 299-E26-10 in January 1999 confirmed the exceedance for indicator parameter specific conductance.
Letter Report (PNNL, 1999, *Groundwater Assessment Plan and Report for the 200 East Area Liquid Effluent Retention Facility*)	1999	Letter assessment plan and report complies with the requirements of 40 CFR 265.93(a), "Preparation, Evaluation, and Response," due to an exceedance of the critical mean for specific conductance. The report concluded that the increase in specific conductance is not due to LERF, but a decreased influence of B Pond dilution and return of the aquifer to natural background levels. This information is also provided in PNNL-13116, *Hanford Site Groundwater Monitoring for Fiscal Year 1999*. The assessment report also acknowledged that a new critical mean was being established for upgradient well 299-E26-11.

Table D-5. Previous Monitoring Plans and Associated Documents Required to Establish a Final Status Monitoring Plan and Network for LERF

Document	Date Issued	Monitoring Program
Ecology Letter (Leja, 1999, "Variance from Interim Status Groundwater Monitoring Requirements at the Liquid Effluent Retention Facility")	1999	Letter provides DOE a variance from specific interim status groundwater monitoring regulations at LERF. This letter states that although LERF is a final status permitted treatment, storage, and disposal facility, groundwater monitoring is regulated under interim status requirements. This variance allows DOE to monitor groundwater in the vicinity of LERF using only two downgradient monitoring wells. Upgradient Well: 299-E26-11. Downgradient Wells: 299-E26-10 and 299-E35-2. Continued monitoring activities in compliance with ECN 603891.
00-GWVZ-039, "Notification of Specific Conductance Exceedance at 200 East Area Liquid Effluent Retention Facility (LERF)"	2000	Letter notifies Ecology that under interim status detection monitoring the average results from the quadruplicate samples collected at wells 299-E26-10 and 299-E35-2 in December 1999 confirmed the exceedance for indicator parameter specific conductance. The letter concluded that the increase in specific conductance is not due to LERF, but a decreased influence of B Pond dilution and return of the aquifer to natural background levels.
Morse, 2001, "Groundwater Monitoring Program at the Liquid Effluent Retention Facility (LERF)"	2001	Letter notifies Ecology that well 299-E35-2 is no longer capable of providing a representative sample for groundwater monitoring. The letter also indicates that DOE will draft a path forward for dealing with this occurrence.
Ecology Letter (Goswami and Jamison, 2001, "Liquid Effluent Retention Facility (LERF) Unsaturated Zone Monitoring alternatives Evaluation, Suspension of Groundwater Monitoring Statistical Evaluation Requirements, LERF RCRA Permit Modification, and Leachate Monitoring Performance Criteria")	2001	This letter suspended further statistical evaluation of groundwater monitoring results associated with the two remaining LERF wells. This suspension is in effect until further notice from Ecology.

Table D-5. Previous Monitoring Plans and Associated Documents Required to Establish a Final Status Monitoring Plan and Network for LERF

Document	Date Issued	Monitoring Program
Class 2 modification of Revision 8 of the Hanford Facility RCRA Permit, Attachment 34, "Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility, and Approved Modification" (WA7890008967, 2004, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion Revision 8*)	2004	Attachment 34 called for determining the groundwater flow characteristics of the unconfined aquifer, including an assessment of barometric pressure fluctuations in the LERF monitoring wells and the potential for these fluctuations to affect hydraulic gradient and groundwater flow direction determinations.
SGW-35756, *Water-Level Barometric Response Analysis for the Liquid Effluent Retention Facility Monitoring Wells*	2007	This plan assessed the effects of barometric pressure fluctuations in upgradient well 299-E26-11 and downgradient well 299-E26-10. Multiple regression was used to analyze the well water level responses to barometric pressure fluctuations. The water level response characteristics indicated that the aquifer is unconfined at well 299-E26-10 and confined at well 299-E26-11. It was also determined that well 299-E26-11 had a significant effect on the trend-surface analysis because the water level elevation in 299-E26-11 was approximately 1 m higher than the other wells. An important recommendation in SGW-35756 was to correct for barometric effects in the two 2008 proposed LERF wells for a more direct determination of long-term groundwater flow conditions.
DOE/RL-2008-41, *Sampling and analysis Plan for the Liquid Effluent Retention Facility (LERF) Replacement RCRA Wells*	2008	This plan drove drilling, hydraulic testing of the fractured basalt aquifer, and chemical analysis comparison of the groundwater within the fractured basalt. The two groundwater wells drilled associated with this plan were wells 299-E26-77 and 299-E26-79 (Figure D-24).
SGW-41072, Rev. 0, *Liquid Effluent Retention Facility Characterization Report*	2009	Described the site characterization and addition of the two wells (299-E26-77 drilled in October 2008 and 299-E26-79 drilled in September 2008) to the monitoring network.

Table D-5. Previous Monitoring Plans and Associated Documents Required to Establish a Final Status Monitoring Plan and Network for LERF

Document	Date Issued	Monitoring Program
SGW-52161, *Resistivity and Electromagnetic Investigation at the LERF, 200 East Area of the Hanford Site, Richland, Washington*	2012	Discusses how two-dimensional electrical resistivity was used to define the contact between the base of the Hanford formation and the upper part of the basalt. Results provided various interpreted resistivity changes reflecting possible fractures and weathered basalt surfaces.
SGW-52162, *Seismic Reflection Investigation at the Liquid Effluent Retention Facility, 200 East Area, Hanford Site Richland, Washington*	2012	Geophysical investigation consisting of check shot surveys, compressional and shear wave reflections at LERF. This investigation was complementary to the work discussed in SGW-52161 for defining the top of the basalt surface, character of the upper part of the basalt, and stratigraphy within the suprabasalt sediments. The results provided a preliminary top of basalt surface beneath LERF.
SGW-52467, *Integrated Surface Geophysical Investigation Results at Liquid Effluent Retention Facility, 200 East Area, Hanford, Washington*	2012	The overall objective of this study was to provide supporting information for locating an upgradient RCRA groundwater monitoring well at LERF, with emphasis on choosing a location that has a strong potential for encountering groundwater, either within the sedimentary column above basalt or within the fractured flow top of the basalt. This document used the geophysical results from SGW-52161 and SGW-52162.
TPA-CN-435, *Tri-Party Agreement Change Notice Form: DOE/RL-2008-41, Rev. 0, Sampling and Analysis Plan for the Liquid Effluent Retention Facility (LERF) Replacement RCRA Wells*	2011	Incorporated drilling and sampling associated with well 299-E26-14 at LERF. Drilling was completed in September 2011.
DOE/RL-2013-46, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility* (Rev. 0)	2013	Final status detection monitoring plan, based on WAC 173-303-645. Indicator parameters included carbon tetrachloride, pH, specific conductance, total organic carbon, and total organic halogens. Sampling frequency was semiannual. Statistical method was Welch's t-Test. No significant exceedances of the indicator parameters were observed.

Table D-5. Previous Monitoring Plans and Associated Documents Required to Establish a Final Status Monitoring Plan and Network for LERF

Document	Date Issued	Monitoring Program

a. The interim detection monitoring program was developed to satisfy the requirements in 40 CFR 265 Subpart F, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Ground-Water Monitoring," and WAC 173-303-400, "Dangerous Waste Regulations," "Interim Status Facility Standards."

b. The final status monitoring plan (PNNL-11620, *Liquid Effluent Retention facility Final-Status Groundwater Monitoring Plan*) was designed to satisfy the requirements of WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program," per General Permit Condition II.F of the Hanford Facility RCRA Permit.

DOE = U.S. Department of Energy

Ecology = Washington State Department of Ecology

ECN = Engineering Change Notice

ETF = Effluent Treatment Facility

LERF = Liquid Effluent Retention Facility

RCRA = *Resource Conservation and Recovery Act of 1976*

WAC = *Washington Administrative Code*

In 1995, the 200 Area ETF began operating. Semiannual indicator parameter detection monitoring indicated there were no significant increases; however, a statistical mean for TOX could not be calculated and as a result the limit of quantitation was used (PNNL-11470).

Annual reporting in 1996 and 1998 reported no evidence of dangerous waste/dangerous waste constituents entering the groundwater from the LERF. However, the 1998 report (PNNL-12086, *Hanford Site Groundwater Monitoring for Fiscal Year 1998*) discussed increased concentrations of calcium, magnesium, sodium, and sulfate at the LERF monitoring network. The calcium, magnesium and sulfate were reported as progressively increasing in concentration since 1994. The report indicated that groundwater chemistry was significantly changing.

In 1999, downgradient monitoring well 299-E26-9 was declared sample dry and 299-E35-2 had less than 1 m (3.3 ft) of water remaining (PNNL-13116, *Hanford Site Groundwater Monitoring for Fiscal Year 1999*, Section 2.9.2.12). As a result, Ecology rejected the final status groundwater monitoring plan (PNNL-11620) in 1999 and reverted to the interim status monitoring plan, WHC-SD-EN-AP-024 with associated ECN 603891.

Continued water table declines from diminishing cooling water discharge, starting in 1988, led to changes in groundwater quality, ability to sample downgradient wells, conceptual model of the basalt hydraulic properties, change in basalt surface and groundwater flow direction. In 1999, groundwater quality changes west of LERF began to affect statistical evaluations for the detection monitoring indicator parameter specific conductance. An assessment report in 1999 attributed elevated specific conductance with decreased influence of 216-B-3 Pond radial migration and return of the aquifer in this area to pre-cooling water discharge levels . Figure D-28 shows how specific conductance has increased from the 1990s to 2016 in wells to the west, northwest and north of LERF. Figure D-29 shows how sulfate, a component of the elevated specific conductance, also increased from the 1990s to 2016 in wells to the west, northwest and north of LERF. Another contributor to the elevated specific conductance is nitrate (Figure D-30).

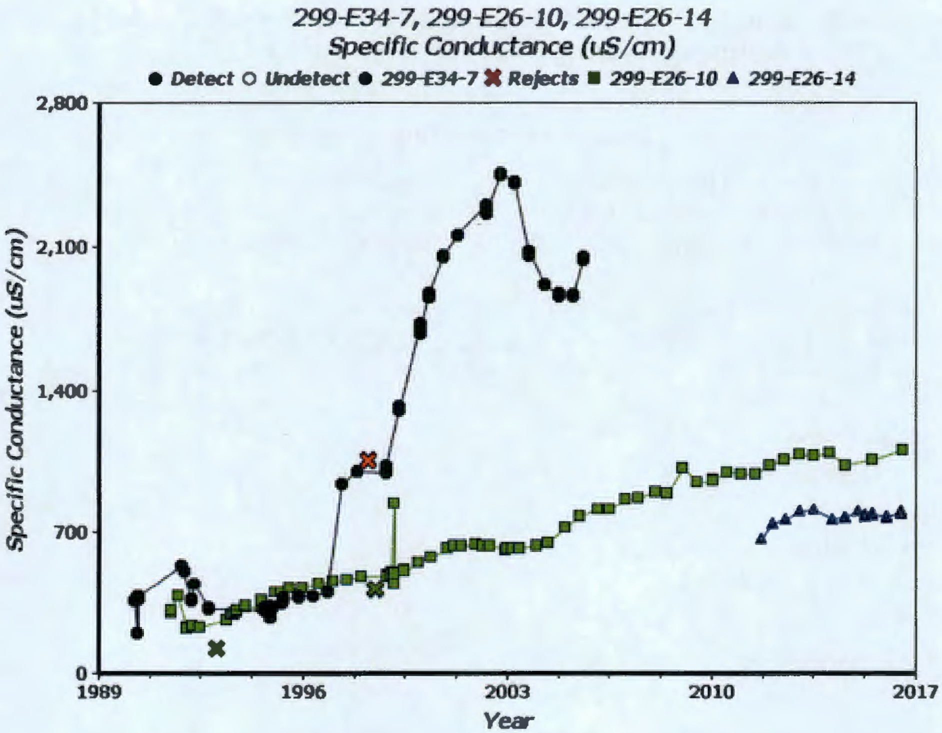


Figure D-28. Groundwater Specific Conductance Trends at Wells 299-E26-10, 299-E26-14, and 299-E34-7 from 1990 to 2016

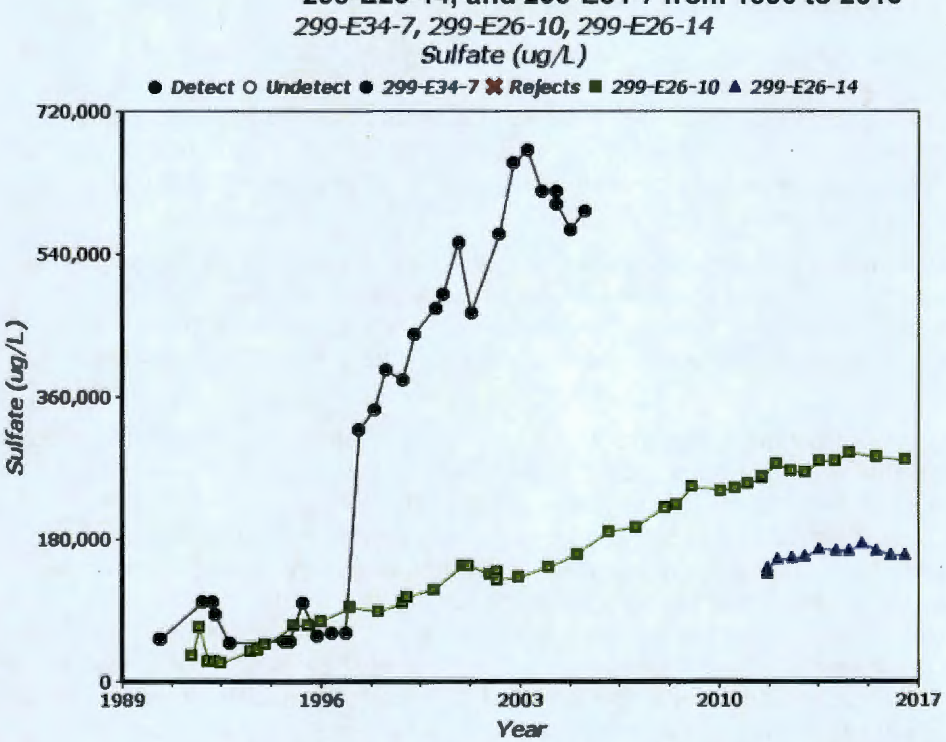


Figure D-29. Groundwater Sulfate Trends at Wells 299-E26-10, 299-E26-14, and 299-E34-7 from 1990 to 2016

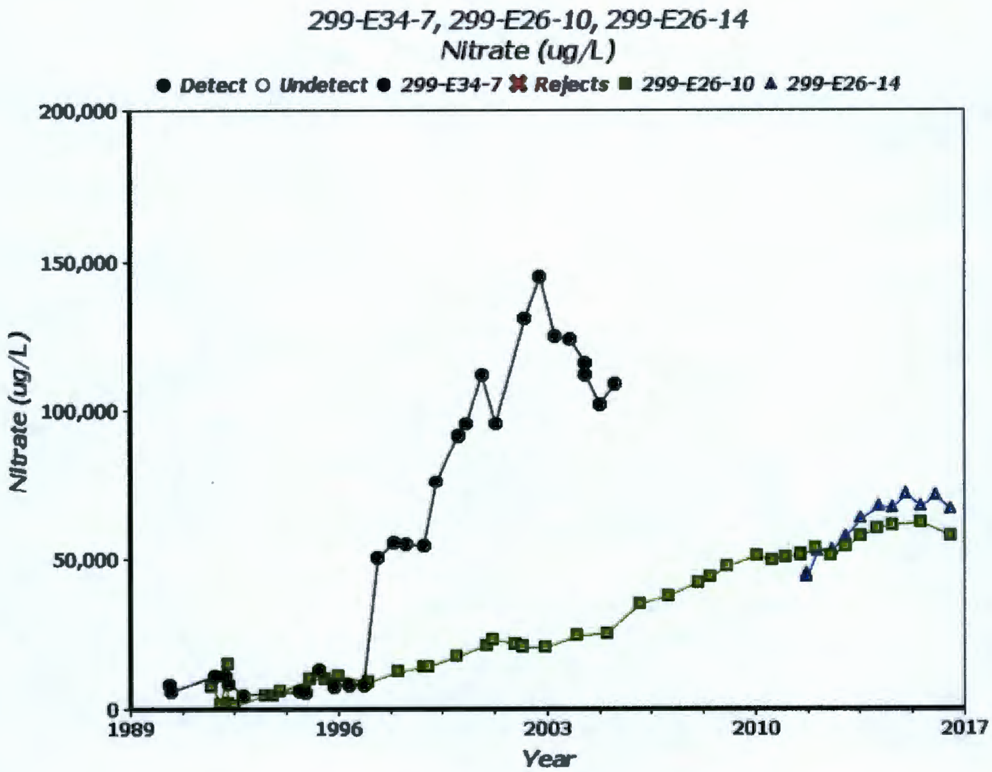


Figure D-30. Groundwater Nitrate Trends at Wells 299-E26-10, 299-E26-14, and 299-E34-7 from 1990 to 2016

An alternative explanation of the increase in specific conductance, nitrate and sulfate may be the results of remobilization of two documented crude product UPRs, cerium rare earth crude (UPR-200-E-32) and strontium nitrate crude (UPR-200-E-138). Both of these releases were associated with nitric acid and TOC. ISO-986, *B-Plant Phase III Flowsheets*, Table 28, provides molecular levels of nitrate and TOC for strontium-90/rare earth recovery processes. The driver of the nitrate remobilization may be attributed to a 1986 wetting front, observed in LLWMA-2 Trench 36 (southwest of well 299-E34-7). An investigation established the water at LLWMA-2 was associated with plugging of the unlined 216-B-2-3 Ditch (WHC-SD-WM-TI-260, *Water Inflow Investigation at the 218-E12A and 218-E-12B Burial Grounds*). This ditch received over a million gallons daily. Various geology reports associated with this area indicate subordinate low permeability sediments dipping to the northeast are continuous to distances of several hundred meters and capable of generating perched water conditions. This explanation appears to resolve the high nitrate concentrations in groundwater, because natural nitrate evaporation minerals (nitrate and niter), which are highly soluble, do not appear to be associated with Hanford formation deposits based on the lack of elevated nitrate in pore water samples at well 299-E33-50 and at Gable Mountain Pond during initial discharges of cooling water. Finally, sulfate was not a significant part of the later strontium-90 fractionation solutions; however, the evaporite mineral gypsum ($CaSO_4 \cdot 2H_2O$) is generally found in subareal arid environments. The dissolution of gypsum produces Ca^{2+} and SO_4^{2-}. These minerals showed similar increasing trends in the groundwater at well 299-E34-7 in the past (Figure D-31). Currently, these minerals trend similarly at upgradient LERF well 299-E26-14 (Figure D-32). Groundwater at well 299-E34-7 was characterized due to elevated specific conductance and TOC concentrations from 2000 to 2005. The characterization included semiannual sample collection and analyses for 40 CFR 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Appendix IX, "Ground-Water Monitoring List," constituents. Other analyses included coliform bacteria, total petroleum hydrocarbons for diesel and gasoline, and oil and grease. PNNL-15670, *Hanford Site Groundwater Monitoring for Fiscal Year 2005*, concluded, "no organic constituents were detected consistently and those detected were at low levels, often associated with blank contamination that appears to be false-positive results." PNNL-15670 also stated, "constituents causing the increased specific conductance in well 299-E34-7 are impacting wells farther southwest," referring to wells 299-E27-10 and 299-E27-9. Increases in specific conductance and TOC are also occurring at well 299-E26-14, upgradient to LERF.

In January 2001, a second downgradient well (299-E35-2) became sample dry, leaving the network with only one downgradient well (299-E26-10) (PNNL-13404, Sections 2.9.2.12 and A.8.8). Therefore, Ecology suspended statistical evaluations of groundwater monitoring (Goswami and Jamison, 2001). Between 2001 and 2004, DOE and Ecology evaluated alternative monitoring plans, developed and finalized a groundwater evaluation plan, and planned the implementation of the plan (Attachment 34, [WA7890008967, 2004]). In 2004, Ecology modified Revision 8 of the Hanford Facility RCRA Permit by adding Attachment 34. Attachment 34 called for determining the groundwater flow characteristics of the unconfined aquifer, including an assessment of barometric pressure fluctuations in the LERF monitoring wells and the potential for these fluctuations to affect hydraulic gradient and groundwater flow direction determinations.

In 2007 SGW-35756 directed field work which determined well 299-E26-11 was confined and well 299-E26-10 was unconfined. It was also determined that well 299-E26-11 had a significant effect on the trend-surface analysis because the water level elevation in 299-E26-11 was approximately 1 m higher than the other wells. An important recommendation in SGW-35756 was to correct for barometric effects in the two 2008 proposed LERF wells for a more direct determination of long-term groundwater flow conditions.

In 2008, DOE/RL-2008-41 drove the installation and hydraulic testing of wells 299-E26-77 and 299-E26-79, which found fractured basalt flowtop was hydraulically connected with the suprabasalt unconfined aquifer and had similar hydraulic properties. As a result, two geophysical investigations were initiated in 2010 to define the extent of the suprabasalt and fractured basalt aquifer and thickness.

In 2009, a characterization report was issued (SGW-41072, Rev. 0) to document the status of the groundwater investigation near the LERF (SGW-41072, Rev. 0, Chapter 1). The report included the site characterization activities and the addition of two wells to the monitoring network (299-E26-77 drilled in October 2008 and 299-E26-79 drilled in September 2008).

Between 2010 and 2012, two geophysical investigations and three reports (SGW-52161, SGW-52162, and SGW-52467) were completed, which included defining the basalt surface and suprabasalt sediments near and beneath LERF.

Upgradient well (299-E26-14) was installed in 2011 based on the unconfined aquifer thickness defined by the geophysical investigation. A subsequent barometric response was defined for well 299-E26-14 and combined with the other unconfined LERF wells, defining a southerly groundwater flow direction beneath LERF. These findings were used to complete the previous LERF monitoring plan (DOE/RL-013-46, Rev. 0) and proposal of well 299-E26-15 installation.

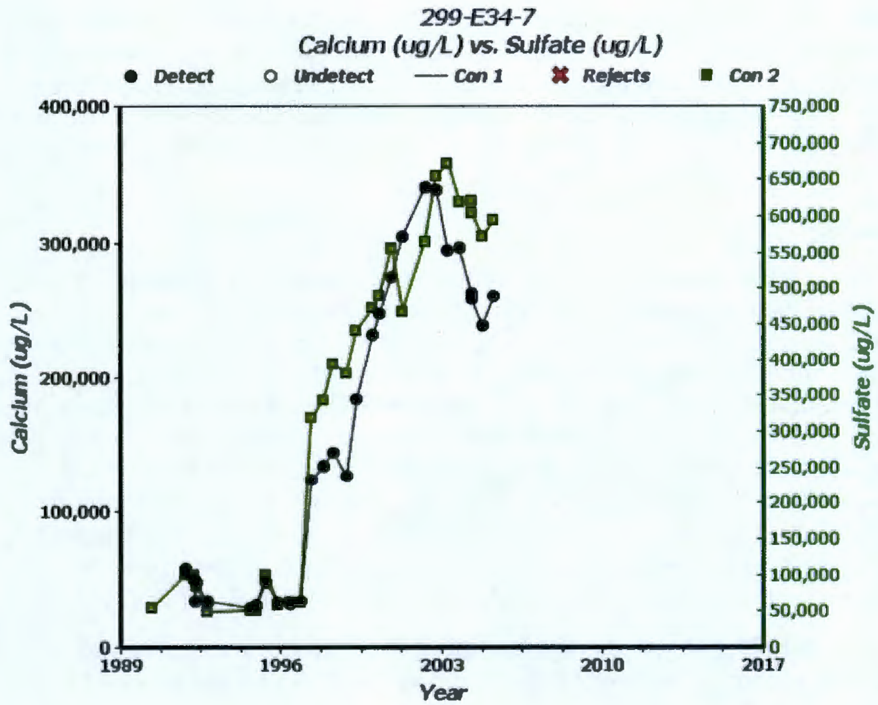


Figure D-31. Past Groundwater Calcium and Sulfate Trends at Well 299-E34-7 from 1990 to 2005

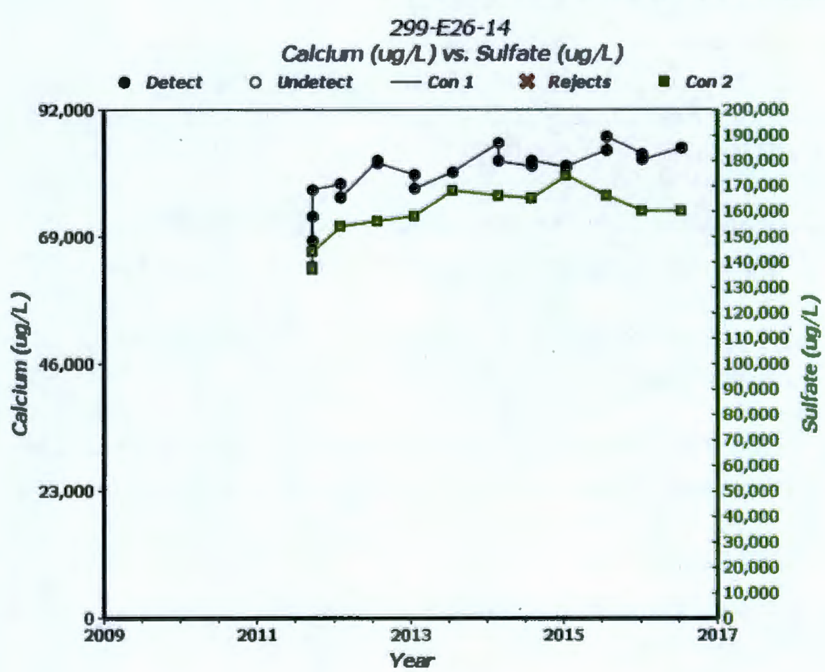


Figure D-32. Recent Groundwater Calcium and Sulfate Trends at Well 299-E26-14 from 2011 to 2016

In 2015, well 299-E26-15 was installed and permit condition III.3.R.3.b drove this revised detection monitoring plan, established in accordance with WAC 173-303-645(9). The purpose of this revised plan is to present an updated groundwater monitoring program that is capable with reasonable confidence of detecting a contaminant release to groundwater from LERF. This plan is intended specifically to satisfy monitoring requirements for final status OUG 3 as prescribed in Part II.F of the Hanford Facility RCRA Permit and as required by WAC 173-303-645. This monitoring plan is the principal controlling document for conducting groundwater monitoring at LERF and is used to modify the permit. Once the permit is modified, this document will supersede DOE/RL-2013-46, Rev. 0.

D.2.6 Conceptual Site Model

This section describes a possible LERF leakage scenario for evaluation of potential contaminant transport to the groundwater and the downgradient monitoring well 299-E26-79. LERF has been in operation since 1994 and has worked with the 200 Area ETF since 1995 as an aqueous waste treatment system. LERF has an operating capacity of 29.5 million L (7.8 million gal.) and the amount of liquid passing through LERF is likely equivalent to the liquid received by the 200 Area ETF. As of the writing of this plan no groundwater dangerous wastes or dangerous waste constituents have been attributed to releases associated with LERF, although groundwater quality has been affected by upgradient sources to the groundwater beneath LERF. Liquid has been collected from the leachate collection and removal system associated with the basins. The leachate collection system consists of a collection sump, which is approximately 3 by 1.8 by 0.3 m (10 by 6 by 1 ft) deep, at the bottom of each basin in the northwest corner. LERF is governed by an action leakage rate in Addendum C of the Hanford Facility RCRA Permit (Section C.5.8).

In this hypothetical CSM, a breachment of the seams in the liners near the collection sump is considered. The following hypothetical release and transport assumptions have been incorporated into the CSM:

- Engineering barrier seams are considered breached near the collection sump.
- A hypothetical release equaling a thousandth of a large leak rate is assumed from Basin 43, 13 L/day (3.4 gal/day).
- Carbon tetrachloride concentrations released are assumed at 490 µg/L.
- The lower soil/bentonite layer is hypothetical considered to have inconsistent mixing and fracturing near the leachate collection system sump, allowing vertical migration of 13 L/day (3.4 gal/day) of leachate to migrate through a 3 by 1.8 m (10 by 6 ft) section of the 91 cm (3 ft) soil/bentonite layer without horizontal migration.
- Vertical and horizontal dispersivity through the Hanford sediments is estimated at 0.1.
- Hanford sediment thickness from the soil/bentonite layer to groundwater is considered 60 m (197 ft).
- Average Hanford vadose zone moisture content is 0.087 percent (WHC-SD-WM-TI-730, *Performance Assessment for the Disposal of Low-Level Waste in the 200 East Area Burial Grounds*).
- Distance from point of release infiltration into aquifer to well 299-E26-79 is 130 m (427 ft).
- Direction of well 299-E26-79 from point of release infiltration into aquifer is approximately 10° west of south.
- Effective porosity of the Hanford formation is 0.1.
- Hydraulic conductivity of the unconfined aquifer is 79 m/day.
- Groundwater gradient is 2.46 x 10-4 m/day.
- Aquifer thickness is 4.2 m.

In this hypothetical release scenario, the primary driver for leachate migration is a release associated with a liner leak at the leachate collection sump. The scenario applies a leak of 13 L/day (3.4 gal/day) of leachate near the leachate collection sump. The leachate migrates through the breached liner and into the 91 cm (3 ft) soil/bentonite layer. It takes approximately 95 days to migrate through the assumed inconsistent mixed/fractured soil/bentonite layer, considering no horizontal migration. As discussed in Addendum C of the LERF and the 200 Area ETF permit, the hydraulic conductivity of the soil/bentonite layer was considered 10^{-7} cm/day. Nearly 68 years is required for the leachate to migrate through the Hanford gravels, assuming a vadose zone moisture content of 8.7 percent (WHC-SD-WM-TI-730). Because of an assumed 0.1 vertical dispersivity coefficient associated with the Hanford gravels, the leachate release entering the aquifer expands to an approximate area of 8 by 8 m (26 by 26 ft). Because of the continuous release source, approximately 0.08 cm/day enters into the aquifer. The flowing unconfined aquifer is influenced for approximately 74 days while moving through the zone of hypothetical leachate infiltration. Calculations indicate a 14% volume of contaminant loading when exiting the zone of leachate infiltration. As the plume migrates towards well 299-E26-79 it disperses. By the time the plume reaches well 299-E26-79, the original leachate concentrations are estimated to be approximately 4% of their original concentration in the basin. Thus, carbon tetrachloride may be as high as 21 µg/L.

Geochemically many of the dangerous waste constituents associated with LERF leachate are metals (cations). Hanford sediments have sufficient cation-exchange capacity to adsorb many of these cations. Considering the substantial thickness of vadose zone (60 m [197 ft]) and the cation-exchange capacity, dangerous waste metal constituents are not considered reliable indicators of the presence of dangerous constituents in the groundwater.

Finally, as shown in the hypothetical carbon tetrachloride transport example, dispersion is a significant decision component to determining the detectability/reliability of LERF waste constituents as indicators of groundwater contamination per WAC 173-303-645(9)(a)(iii). The constituents selected provide the best opportunity to determine whether dangerous waste/dangerous waste constituents may be impacting groundwater while maintaining a balance with the site false positive rate.

D.2.7 Groundwater Detection Monitoring Requirements

The groundwater monitoring program at LERF is conducted in accordance with the objectives identified in WAC 173-303-645, as required by the Hanford Facility RCRA Permit, Part II, Condition II.F. Detection monitoring is implemented in accordance with WAC 173-303-645(9), which requires the establishment and implementation of a groundwater monitoring program with reasonable confidence that a contaminant release to groundwater from a facility will be detected (WAC 173-303-645(8)(g)).

Table D-6 identifies where each detection monitoring program element of WAC 173-303-645(9) is addressed within this plan.

Table D-6. Pertinent WAC 173-303-645(9) Detection Monitoring Groundwater Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
General Groundwater Monitoring Requirements: Groundwater Surface Elevation	According to WAC 173-303-645(8)(f): The groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled.	Section D.1Section D.3.1 Table D-7 Section D.4.3 Appendix B, Section B2.2

Table D-6. Pertinent WAC 173-303-645(9) Detection Monitoring Groundwater Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
Detection Monitoring Program: Indicator parameters, Source Waste Discussion, Waste Characteristics, Detectability, Background Parameters	According to WAC 173-303-645(9)(a): The owner or operator must monitor for indicator parameters (e.g., pH, specific conductance, total organic carbon, total organic halogen, or heavy metals), waste constituents, or reaction products that provide a reliable indication of the presence of dangerous constituents in groundwater. The department will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors: i)Types, quantities, and concentrations of constituents in wastes managed at regulated unit; ii) mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management area; iii) detectability of indicator parameters, waste constituents, and reaction products in groundwater; and, (iv) concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the groundwater background.	Section D.1 Section D.2.3 Section D.3.1 Table D-7 Table D-8
Detection Monitoring Program: Point of Compliance	According to WAC 173-303-645(9)(b): 1) Specify the point of compliance at which the groundwater protection standard applies to LERF; 2) Wells used to monitor LERF comply with parts 1 and 3 of WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells."	Section D.1 Section D.2.5 Section D.3.3
Detection Monitoring Program: Record Keeping	According to WAC 173-303-645(9)(c): 1) must maintain a record of groundwater analytical data as measured and in a form necessary for the chemical parameters and dangerous constituents for determination of statistical significance.	Section D.3.1 Section D.4.4 Appendix A, Section A2.5 Appendix A, Section A3.9 Appendix B, Section B3
Detection Monitoring Program: Sample Frequency Frequency of Point of Compliance Comparison	According to WAC 173-303-645(9)(d): 1) frequency for sample collection and statistical analysis.	Section D.3.1 Table D-7

Table D-6. Pertinent WAC 173-303-645(9) Detection Monitoring Groundwater Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
Detection Monitoring Program: Flow Rate	According to WAC 173-303-645(9)(e): The owner or operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	Section D.2.4.3 Section D.3.1
Detection Monitoring Program: Contaminant Determination	According to WAC 173-303-645(9)(f): The owner or operator must determine whether there is statistically significant evidence of contamination for any chemical parameter of dangerous constituents specified under (d) of this subsection.	Section D.3.1 Section D.3.2 Section D.4.2 Section D.4.3
Detection Monitoring Program: A Contaminant Determination is Triggered	According to WAC 173-303-645(9)(g): If the owner or operator determines there is statistical significant evidence of contamination at the point of compliance from LERF the following must be completed i) Notify department of findings in writing within 7 days. Identify the chemical parameter or dangerous constituent. ii) Immediately sample the groundwater in all wells and determine whether constituent in the list of Appendix "Ground Water Monitoring List", WAC 173-303-110(3)(c), Chemical Testing Methods for Designating Dangerous Waste are present and in what concentration. iii) For any Appendix "Ground-Water Monitoring List" found in the analysis the owner or operator may resample within one month and repeat the analysis for those compounds detected. If the results of the second analysis confirm the initial results, then these constituents will form the basis for compliance monitoring. iv) Within 90 days, submit to the department an application for a permit modification to establish a compliance monitoring program meeting the requirements of WAC 173-303-645(10), or, v) Submit a report demonstrating a source other than the LERF caused the contamination or that the detection is an artifact caused by an error in sampling, analysis, statistical evaluation, or natural variation in groundwater. The report of demonstration may be in lieu of submitting a permit modification application. However, DOE is not relieved of the requirement to submit a permit	Section D.3.2 Section D.4.2 Section D.4.4 Appendix A, Section A2.5

Table D-6. Pertinent WAC 173-303-645(9) Detection Monitoring Groundwater Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
	modification application within the 90 days of determining a significant exceedance unless the demonstration successfully shows that a source other than the regulated unit caused the increase, or that the increase resulted from error in sampling, analysis, or evaluation.	
Detection Monitoring Program: Monitoring Program not Compliant	According to WAC 173-303-645(9)(h): If the owner or operator determines that the detection monitoring program no longer satisfies the requirements of this section, within 90 days, submit an application for a permit modification to make any appropriate changes to the program.	Section D.4.4 Appendix A, Section A2.5
Procedures and Techniques	WAC 173-303-645(8) "General Groundwater Monitoring Requirements": (d) The groundwater monitoring program must include at a minimum, procedures and techniques for: (i) Decontamination of drilling and sampling equipment. (ii) Sample collection. (iii) Sample preservation and shipment. (iv) Analytical procedures and quality assurance. (v) Chain of custody control. Because no additional drilling is planned at this time drilling decontamination is not addressed in this plan.	Section D.3.5, Appendix A, Section A3.3 Appendix B, Chapter B2 Appendix B, Chapter B5
Statistical Evaluation Statistical Methods	WAC 173-303-645(8) "General Groundwater Monitoring Requirements:" (h) Groundwater monitoring data will be evaluated using a specified statistical method. The statistical test will be conducted separately for each dangerous constituent in each well. (i) The statistical method must be appropriate for the distribution of the dangerous constituent. The practical quantification limit used in the statistical method must be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.	Section D.4.2 Appendix A, Section A3.1
Recordkeeping and Reporting	WAC 173-303-645(8), "General Groundwater Monitoring Requirements:" (j) Groundwater monitoring data collected in accordance with WAC 173-303-645(8)(g), including actual levels of constituents	Section D.3.1, Section D.4.4, Appendix A, Section A2.5

Table D-6. Pertinent WAC 173-303-645(9) Detection Monitoring Groundwater Requirements

Groundwater Monitoring Element	Pertinent Requirement*	Section Where Requirement is Addressed in Monitoring Plan
	must be maintained in the facility operating record. The permit specifies when the data must be submitted for review.	Appendix A, Section A3.9 Appendix B, Chapter B3

* Part II, Condition II.F of the Hanford Facility Hanford Facility RCRA Permit specifies that a groundwater monitoring program under final status is subject to the requirements of WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units."

DOE = U. S. Department of Energy

LERF = Liquid Effluent Retention Facility

RCRA = Resource Cons*ervation and Recovery Act of 1976*

WAC = *Washington Administrative Code*

D.3 GROUNDWATER MONITORING PROGRAM

This chapter describes the LERF groundwater detection monitoring program, consisting of a monitoring well network, waste constituents (indicative of a release from LERF), regional upgradient constituents (indicative of changing background conditions), well casing and groundwater quality parameters, field parameters, point of compliance, and sampling and analysis protocols. The monitoring program presented herein has been revised from that presented in the previous plan (DOE/RL-2013-46, Rev. 0).

D.3.1 Constituents List and Sampling Frequency

Table D-7 presents the wells in the groundwater monitoring network, constituents analyzed as required for detection monitoring and sampling frequency for monitoring at LERF. The waste constituents selected provide a reliable indication of the presence of a release from LERF as required by WAC 173-303-645(9)(a). These include:

- The waste constituents were selected based on inventory screening in SGW-41072, Rev. 1 (Chapter 9 and Appendix E). These constituents are a subset of the inventory from the basins. The inventory was screened for mobility using the (K_d), detectability using two times the PQL assuming a 50% dilution, and action level. Detection of these constituents would be indicative of a release from LERF; they are a direct measurement. They include: 1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine.
- The regional upgradient constituents selected based on historical groundwater information showing continued presence in groundwater from sources other than LERF. These constituents will also be used to assess potential changes in background. They include: anions (sulfate and nitrate).
- The well casing and groundwater quality parameters selected as indicators of well quality/corrosion and groundwater quality. These include: metals (calcium, chromium, iron, magnesium, manganese, nickel, potassium, and sodium) and alkalinity.

Field parameters include dissolved oxygen, oxidation reduction potential, pH, temperature, and turbidity. This plan adds 1-butanol and n-nitrosodimethylamine for monitoring and adds a well 299-E26-15 to the monitoring network. The waste constituents, regional upgradient constituents, well casing and groundwater quality parameters, and field parameters will be sampled and analyzed quarterly for the first two years at each of the network wells to set a baseline. After the first two years of sampling are completed, sampling will be performed semiannually. Groundwater flow rate and direction are determined annually (e.g., ECF-HANFORD-16-0139).

Water level measurements will be collected at each sampling event, prior to purging, to determine the groundwater surface elevation as required by WAC 173-303-645(8)(f) to define groundwater flow direction. Additional water levels may be taken to determine the groundwater flow rate and direction, as required by WAC 173-303-645(9)(e), because of the near flat water table conditions. In addition to the water levels collected at the LERF monitoring network wells (299-E26-14, 299-E26-15, and 299-E26-79), nearby wells 299-E26-10 and 299-E26-77 are included for water level measurements only, to evaluate future groundwater flow direction. Water level measurements at 299-E26-10 and 299-E26-77 will be performed at the same frequency as the sampling for the LERF network wells (Table D-7).

Table D-7. Monitoring Well Network for LERF

			Monitoring Required under WAC 173-303-645(9)[a]					Regional Upgradient Constituents		Well Casing/ Groundwater Quality Parameters		Field Parameters				
				Waste Constituents												
Well Name	**Purpose**	**WAC Compliant**	**Water Level**	**1-Butanol**	**Carbon Tetrachloride**	**Hexavalent Chromium**	**n-Nitrosodimethylamine**	**Nitrate**	**Sulfate**	**Metals[b,c]**	**Alkalinity**	**Dissolved Oxygen**	**Oxidation Reduction Potential**	**pH**	**Temperature**	**Turbidity**
299-E26-14[d]	Background	Y	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
299-E26-14[e]	Background	Y	S	S	S	S	S	S	S	S	S	S	S	S	S	S
299-E26-15[d]	Point of Compliance	Y	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
299-E26-15[e]	Point of Compliance	Y	S	S	S	S	S	S	S	S	S	S	S	S	S	S
299-E26-79[d]	Point of Compliance	Y	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
299-E26-79[e]	Point of Compliance	Y	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Wells for Water Level Measurements Only																
299-E26-10[f]	Water Level	Y	Q	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
299-E26-10[g]	Water Level	Y	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
299-E26-77[f]	Water Level	Y	Q	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
299-E26-77[g]	Water Level	Y	S	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table D-7. Monitoring Well Network for LERF

			Monitoring Required under WAC 173-303-645(9)[a]					Regional Upgradient Constituents		Well Casing/ Groundwater Quality Parameters		Field Parameters				
				Waste Constituents												
Well Name	Purpose	WAC Compliant	Water Level	1-Butanol	Carbon Tetrachloride	Hexavalent Chromium	n-Nitrosodimethylamine	Nitrate	Sulfate	Metals[b,c]	Alkalinity	Dissolved Oxygen	Oxidation Reduction Potential	pH	Temperature	Turbidity

a. Monitoring for indicator parameters, dangerous waste constituents, or reaction products that provide a reliable indication of the presence of dangerous constituents in groundwater is required under WAC 173-303-645(9), "Dangerous Waste Regulations," "Releases from Regulated Units," "Detection Monitoring Program." Water level measurements will be taken each time a sample is collected to determine the groundwater surface elevation as required by of WAC 173-303-645(8)(f), "General Groundwater Monitoring Requirements."

b. Metals include calcium, chromium, iron, magnesium, manganese, nickel, potassium, and sodium.

c. Unfiltered samples will be collected in conjunction with filtered samples for select analysis to determine if metal constituents being monitored occur as both suspended and dissolved phases, or in only one state. The evaluation of suspended and dissolved metals provide supporting information for groundwater geochemical characteristics, as well as indication of well integrity such as the presence of dislodged well encrustation, well corrosion products, or failure of the well screen filter pack.

d. Sampling requirements for first 2 years of monitoring to establish new baseline concentrations.

e. Sampling requirements after first 2 years of monitoring is complete.

f. Water levels will be measured at nearby wells at the same frequency as the monitoring network wells. During the first 2 years of monitoring, water levels will be measured quarterly.

g. Water levels will be measured at nearby wells at the same frequency as the monitoring network wells. After the first 2 years of monitoring, water levels will be measured semiannually.

N/A = not applicable

S = semiannually

Q = quarterly

WAC = *Washington Administrative Code*

Y = well is constructed as a resource protection well (WAC 173-160, "Minimum Standard for Construction and Maintenance of Wells")

D.3.1.1 Sampling if Contamination is Determined

If evidence of contamination of any waste constituents identified in Table D-7 is detected during the first two years of baseline monitoring at any point of compliance (downgradient) well, an "immediate" sampling is required at each network well. Depending on the constituent detected, the "immediate" sampling event will monitor for each of the constituents within the associated analytical method category (e.g., metals, volatile organic compounds [VOCs], and semivolatile organic compounds [SVOCs]) of Appendix 5 of Ecology Publication No. 97-407 (Table D-8). For the LERF waste constituents, "immediate" sampling will be performed as follows:

- If 1-butanol or carbon tetrachloride is detected, then sampling for the entire list of VOCs in Table D-8 will be performed
- If hexavalent chromium is detected, then sampling for the entire list of metals in Table D-8 and hexavalent chromium will be performed
- If n-nitrosodimethylamine is detected, then sampling for the entire list of SVOCs in Table D-8 will be performed

During the first 2 years of baseline monitoring, the next quarterly scheduled sampling event will be considered an "immediate" sample under WAC 173-303-645(9)(g)(ii). After the 2 years of baseline monitoring is complete, an "immediate" sampling as discussed above will be conducted at each network well within 8 to 10 weeks after a full set of sampling data from the routine sampling is posted in the Hanford Environmental Information System (HEIS).

If the "immediate" sampling event indicates that waste constituents may be present in the groundwater, then the groundwater may be resampled within a month of sampling data from the "immediate" sampling being posted in HEIS for the detected constituent(s) under WAC 173-303-645(9)(g)(iii). The "resample" is collected from the same well(s) that had the detected constituent(s).

If the second analysis ("resample") confirms the presence of waste constituents, then the detected waste constituents will be the basis for a compliance monitoring program under WAC 173-303-645(10), unless a successful demonstration is made to Ecology in accordance with WAC 173-303-645(9)(g)(vi), showing that a source other than the regulated unit caused the contamination, or that the detected constituents were caused by some error in sampling, analysis, or statistical evaluation, or natural variation in the groundwater. If resampling is not conducted, then detected waste constituents from the "immediate" sampling event will be the basis for a compliance monitoring program unless a successful demonstration to Ecology shows that the regulated unit is not the cause of the detected waste constituents.

Table D-8. Dangerous Waste Constituents for Sampling under WAC 173-303-645(9)(g)(ii)

Constituent	CAS Number	Constituent	CAS Number
Metals			
Antimony	7440-36-0	Mercury	7439-97-6
Arsenic	7440-38-2	Nickel	7440-02-0
Barium	7440-39-3	Selenium	7782-49-2
Beryllium	7440-41-7	Silver	7440-22-4
Cadmium	7440-43-9	Thallium	7440-28-0
Chromium	7440-47-3	Tin	7440-31-5
Cobalt	7440-48-4	Vanadium	7440-62-2

Table D-8. Dangerous Waste Constituents for Sampling under WAC 173-303-645(9)(g)(ii)

Constituent	CAS Number	Constituent	CAS Number
Copper	7440-50-8	Zinc	7440-66-6
Lead	7439-92-1		
Volatile Organic Compounds			
1,1-Dichloroethane	75-34-3	Carbon tetrachloride	56-23-5
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	Chlorobenzene	108-90-7
1,1,1-Trichloroethane	71-55-6	Chloroethane	75-00-3
1,1,1,2-Tetrachloroethane	630-20-6	Chloroform	67-66-3
1,1,2-Trichloroethane	79-00-5	Chloroprene	126-99-8
1,1,2,2-Tetrachloroethane	79-34-5	Dibromochloromethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8	p-Dichlorobenzene (1,4-Dichlorobenzene)	106-46-7
1,2-Dibromoethane	106-93-4	Dichlorodifluoromethane	75-71-8
1,2-Dichloroethane	107-06-2	Ethylbenzene	100-41-4
1,2-Dichloropropane	78-87-5	Ethyl methacrylate	97-63-2
trans-1,2-Dichloroethylene	156-60-5	Isobutanol (Isobutyl alcohol)	78-83-1
1,2,3-Trichloropropane	96-18-4	Methacrylonitrile	126-98-7
cis-1,3-Dichloropropene	10061-01-5	Methyl bromide (Bromomethane)	74-83-9
trans-1,3-Dichloropropene	10061-02-6	Methyl chloride (Chloromethane)	74-87-3
trans-1,4-Dichloro-2-butene	110-57-6	Methyl iodide (Iodomethane)	74-88-4
2-Butanone (Methyl ethyl ketone; MEK)	78-93-3	Methyl methacrylate	80-62-6
2-Propanone (acetone)	67-64-1	Methylene bromide (Dibromomethane)	74-95-3
2-Hexanone	591-78-6	Methylene chloride	75-09-2
4-Methyl-2-pentanone (MIBK)	108-10-1	Propionitrile (Ethyl cyanide)	107-12-0
Acetonitrile; Methyl cyanide	75-05-8	Styrene	100-42-5
Acrolein	107-02-8	Tetrachloroethene	127-18-4
Acrylonitrile	107-13-1	Toluene	108-88-3
Allyl chloride	107-05-1	Trichloroethene (TCE)	79-01-6
Benzene	71-43-2	Trichlorofluoromethane	75-69-4
Bromodichloromethane	75-27-4	Vinyl acetate	108-05-4
Bromoform	75-25-2	Vinyl chloride (Chloroethene)	75-01-4
Carbon disulfide	75-15-0	Xylenes (total)	1330-20-7
Semivolatile Organic Compounds			
1-Naphthylamine	134-32-7	Dimethoate	60-51-5

Table D-8. Dangerous Waste Constituents for Sampling under WAC 173-303-645(9)(g)(ii)

Constituent	CAS Number	Constituent	CAS Number
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	p-(Dimethylamino)azobenzene	60-11-7
1,2,4-Trichlorobenzene	120-82-1	alpha, alpha-Dimethylphenethylamine	122-09-8
1,2,4,5-Tetrachlorobenzene	95-94-3	Dimethyl phthalate	131-11-3
1,4-Dioxane	123-91-1	Di-n-butylphthalate	84-74-2
1,4-Naphthoquinone	130-15-4	m-Dinitrobenzene (1,3-Dinitrobenzene)	99-65-0
2-Acetylaminofluorene	53-96-3	Di-n-octylphthalate	117-84-0
2-Chloronaphthalene	91-58-7	Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	88-85-7
2-Chlorophenol	95-57-8	Diphenylamine	122-39-4
2-Methylphenol (o-cresol)	95-48-7	Disulfoton	298-04-4
2-Methylnaphthalene	91-57-6	Ethyl methanesulfonate	62-50-0
2-Naphthylamine	91-59-8	Famphur	52-85-7
2-Nitrophenol (o-Nitrophenol)	88-75-5	Fluoranthene	206-44-0
2-Picoline	109-06-8	9H-Fluorene (Fluorene)	86-73-7
2,3,4,6-Tetrachlorophenol	58-90-2	Hexachlorobenzene	118-74-1
2,4-Dichlorophenol	120-83-2	Hexachlorobutadiene	87-68-3
2,4-Dimethylphenol	105-67-9	Hexachlorocyclopentadiene	77-47-4
2,4-Dinitrophenol	51-28-5	Hexachloroethane	67-72-1
2,4-Dinitrotoluene	121-14-2	Hexachlorophene	70-30-4
2,4,5-Trichlorophenol	95-95-4	Hexachloropropene	1888-71-7
2,4,6-Trichlorophenol	88-06-2	Indeno(1,2,3-cd)pyrene	193-39-5
2,6-Dichlorophenol	87-65-0	Isodrin	465-73-6
2,6-Dinitrotoluene	606-20-2	Isophorone	78-59-1
3-Methylcholanthrene	56-49-5	Isosafrole	120-58-1
3-Methylphenol (m-Cresol)	108-39-4	Kepone	143-50-0
4-Methylphenol (p-cresol)	106-44-5	Methapyrilene	91-80-5
3,3′-Dichlorobenzidine	91-94-1	Methyl methanesulfonate	66-27-3
3,3′-Dimethylbenzidine	119-93-7	Methyl parathion	298-00-0
4-Aminobiphenyl	92-67-1	Naphthalene	91-20-3
4-Bromophenyl phenyl ether	101-55-3	Nitrobenzene	98-95-3
4-Chloro-3-methylphenol (p-Chloro-m-cresol)	59-50-7	o-Nitroaniline (2-Nitroaniline)	88-74-4
4-Chlorophenyl phenyl ether	7005-72-3	m-Nitroaniline (3-Nitroaniline)	99-09-2
4-Nitroquinoline 1-oxide	56-57-5	p-Nitroaniline (4-Nitroaniline)	100-01-6

Table D-8. Dangerous Waste Constituents for Sampling under WAC 173-303-645(9)(g)(ii)

Constituent	CAS Number	Constituent	CAS Number
4,6-Dinitro-o-cresol (4,6-Dinitro-2-methyl phenol)	534-52-1	p-Nitrophenol (4-Nitrophenol)	100-02-7
5-Nitro-o-toluidine	99-55-8	N-Nitrosodi-n-butylamine	924-16-3
7,12-Dimethylbenz[a]anthracene	57-97-6	N-Nitrosodiethylamine	55-18-5
Acenaphthene	83-32-9	N-Nitrosodimethylamine	62-75-9
Acenaphthylene	208-96-8	N-Nitrosodiphenylamine	86-30-6
Acetophenone	98-86-2	n-Nitroso-di-n-dipropylamine (N-Nitrosodipropylamine; Di-n-propylnitrosamine)	621-64-7
Aniline	62-53-3	N-Nitrosomethylethalamine	10595-95-6
Anthracene	120-12-7	n-Nitrosomorpholine	59-89-2
Aramite	140-57-8	N-Nitrosopiperidine	100-75-4
Benz[a]anthracene (Benzo[a]anthracene)	56-55-3	N-Nitrosopyrrolidine	930-55-2
Benz[e]acephenanthrylene (Benzo[b]fluoranthene)	205-99-2	Parathion	56-38-2
Benzo[k]fluoranthene	207-08-9	Pentachlorobenzene	608-93-5
Benzo[ghi]perylene	191-24-2	Pentachloroethane	76-01-7
Benzo[a]pyrene	50-32-8	Pentachloronitrobenzene	82-68-8
Benzyl alcohol	100-51-6	Pentachlorophenol	87-86-5
Bis(2-chloroethoxy)methane	111-91-1	Phenacetin	62-44-2
Bis(2-chloroethyl)ether	111-44-4	Phenanthrene	85-01-8
Bis(2-chloro-1-methylethyl) ether (2,2'-Oxybis(1-chloropropane))	108-60-1	Phenol	108-95-2
Bis(2-ethylhexyl) phthalate	117-81-7	p-Phenylenediamine	106-50-3
Butylbenzylphthalate	85-68-7	Phorate	298-02-2
p-Chloroaniline (4-Chloroaniline)	106-47-8	Pronamide	23950-58-5
Chlorobenzilate	510-15-6	Pyrene	129-00-0
Chrysene	218-01-9	Pyridine	110-86-1
Diallate	2303-16-4	Safrole	94-59-7
Dibenz[a,h]anthracene	53-70-3	Tetraethyl dithiopyrophosphate	3689-24-5
Dibenzofuran	132-64-9	o-Toluidine	95-53-4
m-Dichlorobenzene (1,3-Dichlorobenzene)	541-73-1	O,O,O-Triethyl phosphorothioate	126-68-1
Diethyl phthalate	84-66-2	sym-Trinitrobenzene	99-35-4

Table D-8. Dangerous Waste Constituents for Sampling under WAC 173-303-645(9)(g)(ii)

Constituent	CAS Number	Constituent	CAS Number
O,O-Diethyl O-2-pyrazinyl phosphorothioate	297-97-2		

Note: This table identifies a subset of the dangerous waste constituents listed in Appendix 5 of Ecology Publication No. 97-407, *Chemical Test Methods For Designating Dangerous Waste WAC 173-303-090 & -100*. The constituents are grouped by analytical method category. The categories in the table correspond to the waste constituents identified for monitoring at the unit. In the event that one or more waste constituents are detected, sampling for each of the dangerous waste constituents in the associated analytical method category (as identified in Section D.1.1) will be performed.

CAS = Chemical Abstracts Service

D.3.1.2 Sample Schedule Impacts from Well Maintenance and Sampling Logistics

Well maintenance (e.g., pump repairs, periodic well cleaning and redevelopment) and sampling logistics resulting from multiple factors including environmental (i.e., inclement weather) and access restrictions (i.e., heightened fire danger, area access restriction due to work by other Hanford contractors such as in the tank farms) sometimes delay scheduled sampling events. Sampling events are scheduled by month. The Field Work Supervisor (FWS) determines the specific times within a given month that a well will be sampled. If a well cannot be sampled at the times determined by the FWS, then the FWS and Sampling Management and Reporting group, along with the project scientist, will consult on how best to recover or reschedule the sampling event as close to the original sampling date as possible. If it is observed during the pre-sampling walkdown that one or more network wells cannot be sampled, then sampling of the well network will not begin and management will be notified. Depending on the situation, the network sampling will be rescheduled within a short time frame (such as 3 to 4 weeks). In some cases, it may not be obvious that sampling cannot be performed until a well is accessed (e.g., an issue with a pump).

Missed sampling events that are not rescheduled within the same month are given top priority when rescheduling sampling for the following month. In the event that a sampling delay has occurred and the representativeness of the samples is in question, DOE-RL and Ecology may agree to resampling wells. DOE-RL will provide informal notification to Ecology if sampling of the network is expected to be delayed for longer than 4 weeks. Ecology may provide input in a timely fashion to DOE-RL on how to proceed. Missed or cancelled sampling events are reported to the DOE-RL and are documented in the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12, *Hanford Site RCRA Groundwater Monitoring Report for 2015*).

D.3.2 Point of Compliance

The point of compliance is defined in WAC 173-303-645(6) as a "…vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units." This is the location in the uppermost aquifer where groundwater monitoring takes place and the groundwater protection standard applies. The point of compliance for LERF is the downgradient monitoring wells (299-E26-15 and 299-E26-79).

D.3.3 Monitoring Well Network

The LERF monitoring network consists of one background (upgradient) and two point of compliance (downgradient) wells. Figure D-2 shows the groundwater monitoring network, and Table D-4 summarizes information for these and other wells used in the discussion of geology and hydrogeology.

Construction details and pertinent information for the wells are provided in Appendix C. Some wells are co-sampled with other monitoring programs (e.g., monitored to meet *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* requirements). Monitoring requirements for other monitoring programs are described in separate plans. The reported data from those other monitoring programs are supplementary to information gathered under this plan.

When a well is within approximately 2 years of going dry, a replacement well will be proposed; such wells are negotiated annually by Ecology, DOE, and EPA under Tri-Party Agreement (Ecology et al., 1989) Milestone M-24-00. The water table at LERF had shown a minimal decline since 2011. Since 2016, the water table has fluctuated significantly in response to Columbia River stages and significant Treatment Effluent Disposal Facility (TEDF) discharge rates ($\geq 10^7$ L/month). Because of the schedule associated with tank retrievals, it appears that significant TEDF discharges will be an ongoing occurrence for several decades. However, should the water table continue to decline at the rate from 2010 to mid-2016, in which the water table dropped 20 cm, it would be approximately 35 years before well 299-E26-15 would go dry. Because the other wells are positioned in deeper parts of the aquifer or within deeper hydraulically connected fracture zones, the other wells should not go dry.

Figure D-26 and D-27 provides a comparison of TEDF discharge volumes in liters per month versus the average groundwater gradient and average groundwater flow direction determinations beneath LERF, respectively. The LERF water level response from TEDF discharges is similar between wells causing no significant change in gradient. However, the water table at well 299-E26-79 appears to increase a centimeter or two more than the other wells during significant TEDF discharges ($>10^7$ L/month) and may be the reason for groundwater flow direction changes of up to 10° west of due south (Figure D-27).

D.3.4 Differences between This Plan and Previous Plan

Table D-9 identifies the main differences between this plan and the previous groundwater monitoring plan (DOE/RL-2013-46, Rev. 0).

Table D-9. Main Differences Between this Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan[b]	Justification Summary
Constituents	**Waste Constituent Indicator Parameter:** Carbon Tetrachloride **Possible Waste Constituent Indicator Parameter** (*Monitored to Determine Background Conditions*) Hexavalent Chromium **Field Indicator Parameters** pH Conductivity **Laboratory Analytical Indicator Parameters** Total Organic Carbon Total Organic Halogen	**Waste Constituents:** 1-Butanol Carbon Tetrachloride Hexavalent Chromium n-Nitrosodimethylamine **Regional Upgradient Constituents:** Sulfate and nitrate **Well Casing and Groundwater Quality Parameters** Metals (calcium, chromium, iron, magnesium, manganese, nickel, potassium, and sodium) Alkalinity	Revised constituent list is based on the results of inventory screening documented in SGW-41072, Rev. 1, *Liquid Effluent Retention Facility Engineering Evaluation and Characterization Report.* The monitoring is based on direct measurement of waste constituents that were contained in the waste streams that were stored in the LERF basins. These include 1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine. Both carbon tetrachloride and hexavalent chromium were

Table D-9. Main Differences Between this Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan[b]	Justification Summary
	Geochemical Parameters Alkalinity Anions Metals	**Field Parameters** Dissolved Oxygen Oxidation reduction potential pH Temperature Turbidity	previously monitored, but with different drivers. Because direct measurements are being taken as an indicator of a release, TOC, TOX, and specific conductance are being dropped from the list. Nitrate and sulfate are retained as regional upgradient constituents indicative of ambient conditions unrelated to a release from the TSD unit. Metals and alkalinity will continue to be monitored as indicators of groundwater quality and well quality/corrosion. The additional field parameters, dissolved oxygen, oxidation reduction potential, temperature, and turbidity have been added to what was already being done.
Point of Compliance	299-E26-79	299-E26-79 and 299-E26-15	Added downgradient well 299-E26-15.
Sampling Frequency	Semiannual	Quarterly for the first two years and semiannually after that.	No recent data have been collected to date for 1-butanol or n-nitrosodimethylamine, and well 299-E26-15 is added to the network. In order to collect a baseline data set, quarterly samples are being collected for the entire network for the first two years. After that the network will revert to semi-annual sampling.
Well Network	4 wells: Upgradient: 299-E26-14	3 wells: Background (Upgradient):	Added well 299-E26-15, removed wells 299-E26-10 and 299-E26-77.

Table D-9. Main Differences Between this Plan and Previous Plan

Type of Change	Previous Plan[a]	Current Plan[b]	Justification Summary
	Downgradient: 299-E26-79 Crossgradient: 299-E26-10 299-E26-77	299-E26-14 Point of Compliance (Downgradient): 299-E26-15 299-E26-79	
Groundwater Flow Direction	South	Same	No change.
Type of Groundwater Monitoring Program	Detection Monitoring	Same	No change.
Statistical Evaluation	Interwell Welch's T-Test	Double quantification rule	Changed from Welch's T-Test to the double quantification rule to evaluate waste constituents (1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine).

a. DOE/RL-2013-46, Rev. 0, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility.*

b. DOE/RL-2013-46, Rev. 1, *Groundwater Monitoring Plan for the Liquid Effluent Retention Facility.*

LERF = Liquid Effluent Retention Facility
TSD = treatment, storage, and disposal

D.3.5 Sampling and Analysis Protocol

In accordance with the Hanford Facility RCRA Permit, the groundwater protection regulations of WAC 173-303-645 dictate the groundwater sampling and analysis requirements applicable to final status OUG-3. The QAPjP outlining the project management structure, data generation and acquisition, analytical procedures, and quality control is provided in Appendix A. Appendix B provides the sampling protocols (e.g., sampling methods, sample handling and custody, management of waste, and health and safety considerations).

D.4 DATA EVALUATION AND REPORTING

This chapter discusses the evaluation and interpretation of data.

D.4.1 Data Review

The data review and verification are discussed in the QAPjP (Appendix A).

D.4.2 Statistical Evaluation

In deciding which constituents are appropriate to determine groundwater contamination, several site-specific considerations were evaluated: site hydrogeology, fate and transport characteristics of potential contaminants at the facility, number of background samples collected for the contaminant, and past background concentrations for the contaminant. Only the waste constituents, 1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine, are evaluated statistically. With the addition of well 299-E26-15 to the network and addition of waste constituents 1-butanol and n-nitrosodimethylamine, the network will be monitored quarterly for the first two years in order to define a baseline data set. After the baseline data set has been collected (eight sampling events over a period of two years), a different statistical approach may be evaluated to look at the LERF data going forward.

The method employed for evaluation of 1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine is based on the double quantification rule. A permit modification will be submitted if the statistical approach is changed. This method allows a procedure for using non-naturally occurring chemicals, such as VOCs and SVOCs, as indicators of groundwater contamination. These constituents are considered excellent indicators because of concentrations in the liquid waste stored in the LERF basins and lack of these constituents in the aquifer. According to the double quantification rule, waste constituents should be evaluated by the following simple, quasi statistical rule: a confirmed exceedance is registered if any well constituent exhibits quantified measurements (i.e., at or above the practical quantitation limit) in two consecutive sample events (EPA 530/R-09-007, *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*). A "sample event" includes both routine sampling and "immediate" sampling that is performed in the event that contamination is detected (see Section D.3.1.1). The practical quantitation limits for 1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine can be found in Table A-2 and are presented in Table D-10 for convenience.

Table D-10. Practical Quantitation Limits for Waste Constituents

Waste Constituent	Practical Quantitation Limit (µg/L)
1-Butanol	100
Carbon Tetrachloride	3
Hexavalent Chromium	10
n-Nitrosodimethylamine	10

It is assumed when estimating a site-wide false positive rate that each well constituent is at equal risk for a specific, definable false positive error. As a justification for this double quantification rule, analytical procedures involved in identifying a reported nondetect value suggest that the error risk is probably much lower for most chemicals analyzed as never detected. Practical quantitation limits are set high enough so that if a chemical is not present at all in the sample, a detected amount will rarely be recorded on a lab sheet. This is particularly the case since method detection limits are often intended as 99% upper prediction limits on the measured signal of an uncontaminated laboratory sample. Consequently, a series of measurements for samples of uncontaminated groundwater will tend to be listed as a string of nondetects with possibly a very occasional low-level detection. Because the observed measurement levels (i.e., instrument signal levels) are usually known only to the chemist, using the reporting limit provides a false positive rate at much less than 1%.

D.4.3 Interpretation

Data are used to interpret groundwater conditions at LERF. Interpretive techniques may include the following:

- **Double Quantification Rule:** This method is employed to determine the presence or absence of waste constituents (1-butanol, carbon tetrachloride, hexavalent chromium, and n-nitrosodimethylamine), migrating from LERF into the point of compliance downgradient wells.
- **Hydrographs:** Graph water levels versus time to determine decreases and increases and seasonal or manmade fluctuations in groundwater levels.
- **Plume maps:** Map distributions of chemical constituent concentrations in the aquifer to determine the extent of contamination. Changes in plume distribution over time assist in determining plume movement and direction of groundwater flow.
- **Trend Plots:** Graph concentrations of constituents versus time to determine increases, decreases, and fluctuations. May be used in tandem with hydrographs and/or water table maps to determine if concentrations relate to changes in water level or groundwater flow directions.
- **Water Table Maps:** Use water table elevations from multiple wells to construct contour maps and estimate flow directions. Groundwater flow is assumed to be perpendicular to lines of equal potential on the maps.

D.4.4 Reporting and Notification

Reporting and notification requirements are provided in this section.

D.4.4.1 Reporting of Groundwater Monitoring Data

Groundwater monitoring results are submitted in accordance with the requirements of WAC 173-303-645(8)(j). Reporting will be made in the annual Hanford Site RCRA groundwater monitoring reports (e.g., DOE/RL-2016-12) and submitted by March 1. Groundwater flow rate and direction in the uppermost aquifer will be determined in accordance with WAC 173-303-645(9)(e) and included in the Hanford Site RCRA groundwater monitoring reports (e.g., DOE/RL-2016-12).

D.4.4.2 Notification of Contamination at Point of Compliance Wells

If the evaluation presented in Section D.4.2 identifies statistically significant evidence of contamination for waste constituents identified in Table D-7 constituents during the first 2 years of baseline monitoring, at any point of compliance well identified in Section D.3.3, then Ecology will be notified in writing within 7 days in accordance with WAC 173-303-645(9)(g)(i). The notification will specify which waste constituents have shown statistically significant evidence of contamination.

As described in Section D.3.1.1, if the presence of waste constituents in the groundwater is confirmed and the regulated unit is the source, then an application for a permit modification to establish a compliance monitoring program under WAC 173-303-645(10) will be submitted in accordance with WAC 173-303-645(9)(g)(iv) and (v).

Alternatively, if a source other than LERF caused the contamination; or if the exceedance is a result of an error in sampling, analysis, or statistical evaluation; or is a natural variation in groundwater, this may be demonstrated to Ecology in addition to, or in lieu of, submitting a permit modification application under WAC 173-303-645(9)(g)(iv). If pursued, within 7 days of determining statistically significant evidence of contamination, Ecology will be notified in writing that a demonstration will be prepared

(WAC 173-303-645(9)(g)(vi)(A)). Submittal of a report demonstrating the source of the contamination and an application for a permit modification will be performed in accordance with WAC 173-303-645(9)(g)(vi)(B) and (C). If the demonstration is not successful, the time specified for the permit modification required under WAC 173-303-645(9)(g)(iv) remains applicable.

D.4.4.3 Changes to the Detection Monitoring Program

In accordance with Hanford Facility RCRA Permit Condition II.F, Part III, Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility Operating Unit Group 3 (OUG-3), and WAC 173-303-645(9)(h), if it is determined by DOE that the detection monitoring program no longer satisfies the requirements of WAC 173-303-645(9), an application for a permit modification to make any appropriate changes to the detection monitoring program will be submitted within 90 days.

Under the provisions allowed by WAC 171-303-645(1)(e)(ii), submittal of a permit modification within 90 days is not required if the change to the detection monitoring program is a replacement-in-kind well installed adjacent to a well that is going, or has gone, dry. After two such replacements wells are installed, then a permit modification in accordance with WAC 173-303-645(9)(h) must be submitted.

D.4.5 Compliance Monitoring Outline

The following is the outline for the compliance monitoring program:

1. Introduction
2. Background
3. Groundwater Monitoring Program
4. Data Evaluation and Reporting
5. References

Appendix A – Quality Assurance Project Plan
Appendix B – Sampling Protocol
Appendix C – Well Construction
Appendix D – Sample Results

D.5 REFERENCES

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

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APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

FIGURES

TABLE

1 **TERMS**

DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQA	data quality assessment
DQI	data quality indicator
DUP	duplicate (laboratory)
EB	equipment blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FSO	Field Sampling Operations
FTB	full trip blank
FWS	Field Work Supervisor
FXR	field transfer blank
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
MDL	method detection limit
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
PQL	practical quantitation limit
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
S&GRP	Soil and Groundwater Remediation Project
SAF	Sampling Authorization Form
SMR	Sample Management and Reporting
SPLIT	field split
SUR	surrogate

Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989a)
TSD	treatment, storage, and disposal
VOC	volatile organic compound
WAC	*Washington Administrative Codes*

A1 INTRODUCTION

A quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection. It includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection requirements and controls based on the quality assurance (QA) elements found in EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5), and DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD). The *Department of Defense/Department of Energy Consolidated Quality System Manual for Environmental Laboratories* (DoD/DOE QSM, 2013) is also discussed. Sections 6.5 and 7.8 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*) require QA/quality control (QC) and sampling and analysis activities to specify QA requirements for treatment, storage, and disposal (TSD) units, as well as for past-practice processes. This QAPjP also describes the applicable requirements and controls based on guidance provided in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, and EPA/240/R-02/009, *Guidance for Quality Assurance Project Plans* (EPA QA/G-5). This QAPjP is intended to supplement the contractor's environmental QA program plan.

This QAPjP is divided into the following three sections, which describe the quality requirements and controls applicable to the Liquid Effluent Retention Facility groundwater monitoring activities:

- Section A2, Project Management
- Section A3, Data Generation and Acquisition
- Section A4, Data Review and Usability

A2 PROJECT MANAGEMENT

This chapter addresses the management approaches planned, project goals, and planned documentation.

A2.1 Project/Task Organization

Project organization (regarding routine groundwater monitoring) is described in the following subsections and illustrated in Figure A-1.

A2.1.1 DOE-RL Manager

Hanford Site cleanup is the responsibility of U.S. Department of Energy (DOE), Richland Operations Office (RL). The DOE-RL Manager is responsible for authorizing the contractor to perform activities at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Resource Conservation and Recovery Act of 1976* (RCRA); *Atomic Energy Act of 1954*; and the Tri-Party Agreement (Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*).

A2.1.2 DOE-RL Project Lead

The DOE-RL Project Lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to the DOE-RL management.

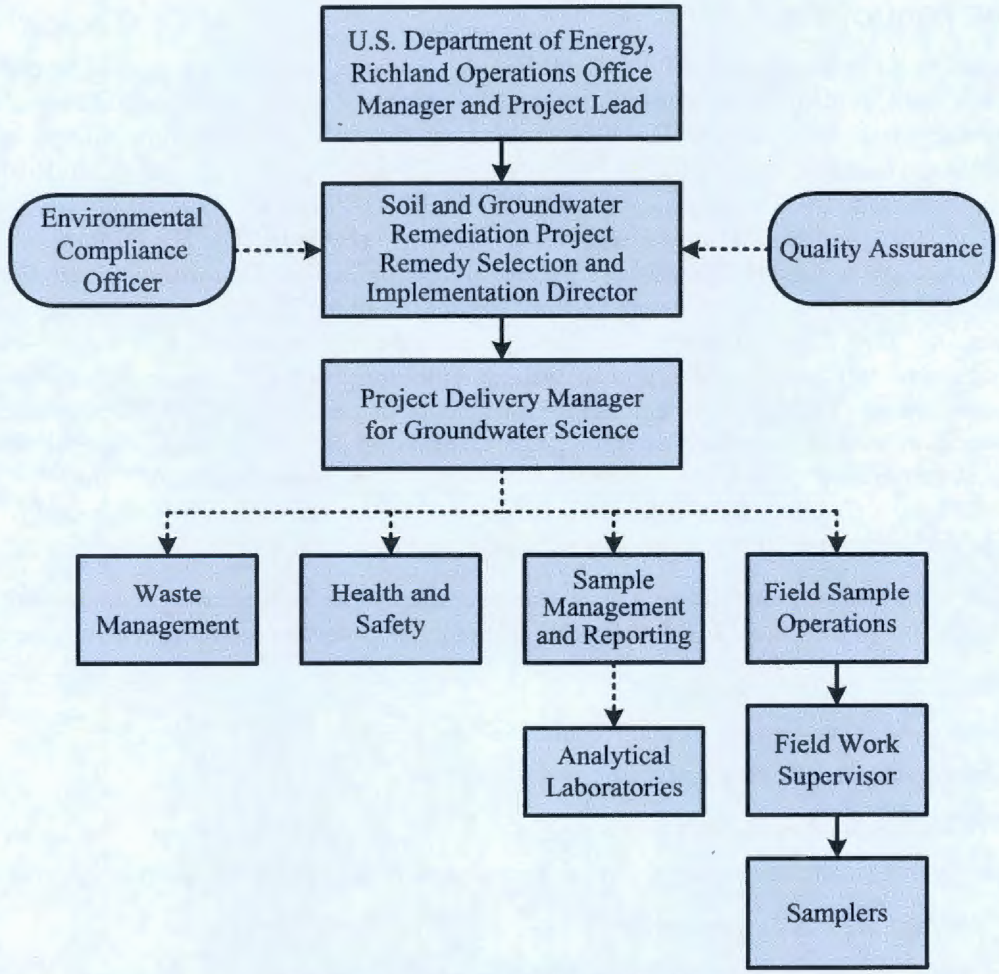

Figure A-1. Project Organization

A2.1.3 Soil and Groundwater Remediation Remedy Selection and Implementation Director

The Soil and Groundwater Remediation Project (S&GRP) Remedy Selection and Implementation Director provides oversight and coordinates with DOE-RL and primary contractor management in support of sampling and reporting activities. The Remedy Selection and Implementation Director also provides support to the Project Delivery Manager for Groundwater Science to ensure that work is performed safely and cost effectively.

A2.1.4 Project Delivery Manager for Groundwater Science

The Project Delivery Manager for Groundwater Science is responsible for direct management of activities performed to meet TSD unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science coordinates with, and reports to, DOE-RL and primary contractor management regarding TSD unit groundwater monitoring requirements. The Project Delivery Manager for Groundwater Science (or designee) works closely with the Environmental Compliance Officer (ECO), QA, Health and Safety, and Sample Management and Reporting (SMR) group to integrate these and other technical disciplines in planning and implementing the work scope. The Project Delivery Manager for Groundwater Science assigns scientists to provide technical expertise.

A2.1.5 Sample Management and Reporting Group

The SMR group oversees offsite analytical laboratories, coordinates laboratory analytical work to ensure that laboratories conform to the requirements of this plan, and verifies that laboratories are qualified for performing Hanford Site analytical work. The SMR group generates field sampling documents, labels, and instructions for field sampling personnel and develops the Sampling Authorization Form (SAF), which provides information and instruction to the analytical laboratories. The SMR group ensures that field sampling documents are revised to reflect approved change. The SMR group receives analytical data from the laboratories, ensures it is appropriately reviewed, performs data entry into the Hanford Environmental Information System (HEIS) database, and arranges for data validation and recordkeeping. The SMR group is responsible for resolving sample documentation deficiencies or issues associated with Field Sampling Operations (FSO), laboratories, or other entities. The SMR group is responsible for informing the Project Delivery Manager for Groundwater Science of any issues reported by the analytical laboratories.

A2.1.6 Field Sampling Operations

FSO is responsible for planning and coordinating field sampling resources and providing the Field Work Supervisor (FWS) with routine groundwater sampling documents. The FWS directs the nuclear chemical operators (samplers), who collect groundwater samples in accordance with this groundwater monitoring plan and corresponding standard procedures and work packages. The FWS ensures that deviations from field sampling documents or problems encountered in the field are documented appropriately (e.g., in the field logbook). The FWS ensures that samplers are trained and available. Samplers collect samples in accordance with sampling documentation. Samplers also complete field logbooks, data forms, and chain-of-custody forms, including any shipping paperwork, and package samples for delivery to the analytical laboratory.

Prejob briefings are conducted by FSO, in accordance with work management and work release requirements, to evaluate activities and associated hazards by considering the following factors:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required

A2.1.7 Quality Assurance

The QA point of contact provides independent oversight and is responsible for addressing QA issues on the project and overseeing implementation of the project QA requirements. The QA point of contact responsibilities include reviewing project documents, including the QAPjP, and participating in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.8 Environmental Compliance Officer

ECOs provides technical oversight, direction, and accept project and subcontracted environmental work. They also develop mitigation measures, with the goal of minimizing adverse environmental impacts.

A2.1.9 Health and Safety

The Health and Safety organization coordinates industrial safety and health support within the project as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulations or internal primary contractor work requirements.

A2.1.10 Waste Management

Waste Management identifies waste management sampling/characterization requirements to ensure regulatory compliance and is responsible for data interpretation to determine waste designations and profiles. Waste Management communicates policies and practices and ensures project compliance for waste storage, transportation, disposal, and tracking in a safe and cost effective manner.

A2.1.11 Analytical Laboratories

The analytical laboratories analyze samples in accordance with established procedures and the requirements of this plan and provide data packages containing analytical and QC results. Laboratories provide explanations of results to support data review and resolve analytical issues. Statements of work flow down quality requirements consistent with the HASQARD (DOE/RL-96-68). The laboratories are evaluated under the DOE Consolidated Audit Program to DoD/DOE QSM (2013) requirements and must be accredited by the Washington State Department of Ecology (Ecology) for S&GRP analyses performed.

A2.2 Problem Definition/Background

The purpose of this groundwater monitoring plan is to satisfy WA7890008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit, Dangerous Waste Portion, Revision 8C, for the Treatment, Storage, and Disposal of Dangerous Waste*, Part II, Condition II.F, which specifies groundwater monitoring under WAC 173-303-645, "Dangerous Waste Regulations," "Releases from Regulated Units," for final status facilities. More specific information on the activities to satisfy these requirements is provided in the main text of this monitoring plan in Chapter 1 and Sections D.2.7, D.3.1, D.3.2, D.3.3, D.3.4, and D.4.2. Background information on monitoring is also provided in the main text (Sections D.2.2 and D.2.5).

A2.3 Project/Task Description

The focus of this plan is to provide groundwater monitoring in accordance with WAC 173-303-645, evaluate the well network, and interpret analytical results. Specific groundwater monitoring program requirements are provided in Section D.2.7 of the main text. The constituents and parameters to be monitored, along with the monitoring wells and frequency of sampling, are provided in the main text (Chapter 3). Information on the collection and analyses of groundwater from the monitoring network is provided in this appendix and in Appendix B.

A2.4 Quality Assurance Objectives and Criteria

The QA objective of this plan is to ensure that the generation of analytical data of known and appropriate quality is acceptable and useful in order to meet the evaluation requirements stated in the monitoring plan. In support of this objective, data descriptors known as data quality indicators (DQIs) are used to help determine the acceptability and usefulness of the data to the user. Principal DQIs are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These DQIs are defined for the purposes of this document in Table A-1.

Table A-1. Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Corrective Actions
Precision (field duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or re-measurement. • Qualify the data before use.
Accuracy (laboratory control samples, matrix spikes, and surrogates)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include standard recoveries, laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or re-measurement.

Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • If data are not usable, flag as appropriate. • Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability (field duplicates, field splits, matrix spike duplicates and matrix spikes)	Comparability expresses the degree of confidence with which one data set can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and quality assurance protocols.	If data are not comparable to other data sets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.

Completeness (no QC element; addressed in data quality assessment)	Completeness is a measure of the amount of valid data collected compared to the amount of data planned. Measurements are considered to be valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/acceptance criteria).	If data set does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.

Bias (full trip blanks, field transfer blanks [e.g., for VOCs], laboratory control samples, method blanks, matrix spikes, and equipment blanks)	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling processes to limit preferential selection or loss of sample media. • Use sample handling processes, including proper sample preservation, that limit the loss or gain of constituents to the sample media. • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as practicable. Otherwise, samples are sent to other laboratories for analysis.
Sensitivity (method detection limit, practical quantitation limit, and relative percent difference)	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation[b] is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or re-measurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Source: SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*, as amended.

a. Acceptance criteria for QC elements are provided in Table A-4.

b. For purposes of this groundwater monitoring plan, the lower limit of quantitation is interchangeable with the practical quantitation limit.

QC = quality control

VOC = volatile organic compound

Data quality is defined by the degree of rigor in the acceptance criteria assigned to DQIs. The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and requirements of the analytical method. DQIs are evaluated during the data quality assessment (DQA) process (Section A4.3).

A2.5 Documents and Records

The Project Delivery Manager for Groundwater Science (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan is used and provides any updates to field personnel. Elements of the monitoring plan that are required by WAC 173-303-645(8)(f) (e.g., water level measurements will be collected each time a sample is obtained) cannot be changed.

Logbooks and data forms are required to document field activities. The logbook must be identified with a unique project name and number. Individuals responsible for the logbooks shall be identified in the front of the logbook, and only authorized individuals may make entries into the logbooks. Logbooks will be controlled in accordance with internal work requirements and processes.

The FWS, SMR group, and field crew supervisors are responsible for ensuring that field instructions are maintained and aligned with any revisions or approved changes to the groundwater monitoring plan. The SMR group will ensure that any deviations from the plan are reflected in revised field sampling documents for the samplers and analytical laboratory. The FWS or appropriate field crew supervisors will ensure that deviations from the plan or problems encountered in the field are documented appropriately (e.g., in the field logbook).

The Project Delivery Manager for Groundwater Science, FWS, or designee is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities. The Project Delivery Manager for Groundwater Science is also responsible for ensuring that project files are set up and/or maintained. The project files will contain project records or references to their storage locations. Project files generally include the following information:

- Operational records and logbooks
- Data forms
- Global positioning system data (a copy will be provided to the SMR group)
- Inspection or assessment reports and corrective action reports
- Field summary reports
- Interim progress reports
- Final reports
- Forms required by WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," and the master drilling contract

The following records are managed and maintained by SMR personnel:

- Completed field sampling logbooks
- Groundwater sample reports and field sample reports
- Completed chain-of-custody forms
- Sample receipt records
- Laboratory data packages
- Field measurement results

- Analytical data verification and validation reports
- Analytical data case file purges (i.e., raw data purged from laboratory files) provided by offsite analytical laboratories

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information
- Training records for employees, as they relate to analytical methods.
- Laboratory state accreditation records
- Laboratory audit records

Convenience copies of laboratory analytical results are maintained in the HEIS database. Records may be stored in either electronic (e.g., in the managed records area of the Integrated Document Management System) or hardcopy format (e.g., DOE Records Holding Area). Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure the accuracy and retrievability of stored records. Records required by the Tri-Party Agreement (Ecology et al., 1989a) will be managed in accordance with the requirements therein. Records of analyses required by WAC 173-303-645 and groundwater surface elevations required by WAC 173-303-645(8) are to be maintained throughout the active life of a facility and post-closure care period.

Groundwater monitoring results are reported annually in the annual Hanford Site RCRA groundwater monitoring report (e.g., DOE/RL-2016-12, *Hanford Site RCRA Groundwater Monitoring Report for 2015*).

A3 DATA GENERATION AND ACQUISITION

This chapter addresses data generation and acquisition to ensure that the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. Requirements for instrument calibration and maintenance, supply inspections, and data management are also addressed.

A3.1 Analytical Method Requirements

Analytical method requirements for samples are presented in Table A-2. Updated U.S. Environmental Protection Agency (EPA) methods (e.g., updates to SW-846) may be substituted for the analytical methods identified in Table A-2. The updated methods will be able to achieve the PQLs identified in Table A-2.

A3.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with HASQARD (DOE/RL-96-68) requirements (as applicable). Field analytical methods may also be performed in accordance with manufacturer manuals. Table A-2 provides the parameters (if any) identified for field measurements. Appendix B provides further discussion on field measurements.

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Waste Constituents		
1-Butanol	SW-846 Method 8260	100
Carbon tetrachloride		3
Hexavalent chromium	EPA Method 7196	10
n-Nitrosodimethylamine	SW-846 Method 8270	10
Regional Upgradient Constituents		
	EPA/600 Method 300.0 or SW-846 Method 9056	
Nitrate[c]		250
Sulfate[c]		550
Well Casing/Groundwater Quality Parameters[d]		
Calcium	SW-846 Method 6010	1,000
Chromium		10
Iron		100
Magnesium		1,000
Manganese		15
Nickel		40
Potassium		5,000
Sodium		1,000
Alkalinity[d]	EPA/600 Method 310.1 or SW-846 Method 2320	5,000
Field Parameters		
Dissolved oxygen	Field measurement instrument/meter	N/A
Oxidation reduction potential		N/A
pH		N/A
Temperature		N/A
Turbidity		N/A

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Dangerous Waste Constituents Identified in Appendix 5 of Ecology Publication 97-407[c]		
Metals		
Antimony	SW-846 Method 6010	60
Arsenic		10
Barium		100
Beryllium		5
Cadmium		5
Chromium		10
Cobalt		50
Copper		25
Lead		15
Nickel		40
Selenium		50
Silver		10
Thallium		50
Tin		100
Vanadium		50
Zinc		20
Mercury	SW-846 Method 7470	0.5
Volatile Organic Compounds		
1,1-Dichloroethane	SW-846 Method 8260	10
1,1-Dichloroethene (1,1-Dichloroethylene)		10
1,1,1-Trichloroethane		5
1,1,1,2-Tetrachloroethane		1.7
1,1,2-Trichloroethane		5
1,1,2,2-Tetrachloroethane		5
1,2-Dibromo-3-chloropropane		5
1,2-Dibromoethane		5

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
1,2-Dichloroethane		5
1,2-Dichloropropane		5
trans-1,2-Dichloroethylene		5
1,2,3-Trichloropropane		5
cis-1,3-Dichloropropene		5
trans-1,3-Dichloropropene		5
trans-1,4-Dichloro-2-butene		50
2-Butanone (methyl ethyl ketone; MEK)		10
2-Propanone (acetone)		20
2-Hexanone		20
4-Methyl-2-pentanone (MIBK)		10
Acetonitrile; Methyl cyanide		100
Acrolein		100
Acrylonitrile		100
Allyl chloride		10
Benzene		5
Bromodichloromethane		5
Bromoform		5
Carbon disulfide		5
Carbon Tetrachloride		3
Chlorobenzene		5
Chloroethane		10
Chloroform		5
Chloroprene		10
Dibromochloromethane		5
p-Dichlorobenzene (1,4-Dichlorobenzene)		4
Dichlorodifluoromethane		10
Ethylbenzene		4

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Ethyl methacrylate		10
Isobutanol (Isobutyl alcohol)		500
Methacrylonitrile		10
Methyl bromide (Bromomethane)		10
Methyl chloride (Chloromethane)		10
Methyl iodide (Iodomethane)		10
Methyl methacrylate		10
Methylene bromide (Dibromomethane)		10
Methylene chloride		5
Propionitrile (Ethyl cyanide)		10
Styrene		5
Tetrachloroethene		5
Toluene		5
Trichloroethene (TCE)		1
Trichlorofluoromethane		10
Vinyl acetate		50
Vinyl chloride (chloroethene)		10
Xylenes (total)		10
Semivolatile Organic Compounds		
1-Naphthylamine	SW-846 Method 8270	25
1,2-Dichlorobenzene (o-Dichlorobenzene)		10
1,2,4-Trichlorobenzene		13
1,2,4,5-Tetrachlorobenzene		20
1,4-Dioxane		10
1,4-Naphthoquinone		50
2-Acetylaminofluorene		100
2-Chloronaphthalene		10
2-Chlorophenol		10

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
2-Methylphenol (o-Cresol)		10
2-Methylnaphthalene		10
2-Naphthylamine		10
2-Nitrophenol (o-Nitrophenol)		10
2-Picoline		20
2,3,4,6-Tetrachlorophenol		50
2,4-Dichlorophenol		10
2,4-Dimethylphenol		10
2,4-Dinitrophenol		50
2,4-Dinitrotoluene		10
2,4,5-Trichlorophenol		10
2,4,6-Trichlorophenol		10
2,6-Dichlorophenol		10
2,6-Dinitrotoluene		10
3-Methylcholanthrene		20
3- and 4-Methylphenol (m- and p-Cresol)		20
3,3′-Dichlorobenzidine		50
3,3′-Dimethylbenzidine		50
4-Aminobiphenyl		50
4-Bromophenyl phenyl ether		10
4-Chloro-3-methylphenol (p-Chloro-m-cresol)		10
4-Chlorophenyl phenyl ether		10
4-Nitroquinoline 1-oxide		100
4,6-Dinitro-o-cresol (4,6-Dinitro-2-methyl phenol)		20
5-Nitro-o-toluidine		20
7,12-Dimethylbenz[a]anthracene		20
Acenaphthene		10

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Acenaphthylene (Acenaphthylene)		10
Acetophenone		10
Aniline		10
Anthracene		10
Aramite		20
Benz[a]anthracene (Benzo[a]anthracene)		10
Benz[e]acephenanthrylene (Benzo[b]fluoranthene)		10
Benzo[k]fluoranthene		10
Benzo[ghi]perylene		10
Benzo[a]pyrene		10
Benzyl alcohol		10
Bis(2-chloroethoxy)methane		10
Bis(2-chloroethyl)ether		10
Bis(2-chloro-1-methylethyl) ether (2,2'-Oxybis(1-chloropropane))		10
Bis(2-ethylhexyl) phthalate		10
Butyl benzyl phthalate		10
p-Chloroaniline (4-Chloroaniline)		10
Chlorobenzilate		10
Chrysene		10
Diallate		20
Dibenz[a,h]anthracene		10
Dibenzofuran		10
m-Dichlorobenzene (1,3-Dichlorobenzene)		10
Diethyl phthalate		10
O,O-Diethyl O-2-pyrazinyl phosphorothioate		50
Dimethoate		20

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
p-(Dimethylamino)azobenzene		10
alpha, alpha-Dimethylphenethylamine		50
Dimethyl phthalate		10
Di-n-butyl phthalate		10
m-Dinitrobenzene (1,3-dinitrobenzene)		10
Di-n-octyl phthalate		10
Dinoseb (2-sec-Butyl-4,6-dinitrophenol)		20
Diphenylamine		10
Disulfoton		50
Ethyl methanesulfonate		10
Famphur		100
Fluoranthene		10
9H-Fluorene (Fluorene)		10
Hexachlorobenzene		10
Hexachlorobutadiene		10
Hexachlorocyclopentadiene		10
Hexachloroethane		10
Hexachlorophene		500
Hexachloropropene		100
Indeno(1,2,3-cd)pyrene		10
Isodrin		10
Isophorone		10
Isosafrole		20
Kepone		100
Methapyrilene		50
Methyl methanesulfonate		10
Methyl parathion		10

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Naphthalene		10
Nitrobenzene		10
o-Nitroaniline (2-Nitroaniline)		10
m-Nitroaniline (3-Nitroaniline)		10
p-Nitroaniline (4-Nitroaniline)		10
p-Nitrophenol (4-Nitrophenol)		10
N-Nitrosodi-n-butylamine		10
N-Nitrosodiethylamine		10
N-Nitrosodimethylamine		10
N-Nitrosodiphenylamine		10e
n-Nitroso-di-n-dipropylamine (N-Nitrosodipropylamine; Di-n-propylnitrosamine)		10
N-Nitrosomethylethalamine		10
n-Nitrosomorpholine		10
N-Nitrosopiperidine		10
N-Nitrosopyrrolidine		10
Parathion		50
Pentachlorobenzene		10
Pentachloroethane		50
Pentachloronitrobenzene		50
Pentachlorophenol		10
Phenacetin		20
Phenanthrene		10
Phenol		10f
p-Phenylenediamine		500
Phorate		50
Pronamide		20
Pyrene		10
Pyridine		20

Table A-2. Analytical Requirements for Groundwater Analysis

Constituent	Analytical Method[a]	Highest Allowable Practical Quantitation Limit[b] (µg/L)
Safrole		20
Tetraethyl dithiopyrophosphate		50
o-Toluidine		20
O,O,O-Triethyl phosphorothioate		50
sym-Trinitrobenzene		50

Reference: Ecology Publication 97-407, *Chemical Test Methods For Designating Dangerous Waste* WAC 173-303-090 & -100

Note: Analytical methods and highest allowable PQLs provided in this table do not represent EPA requirements but are intended solely as guidance.

a. For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Methods 310.1, see EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*. Equivalent methods may be substituted.

b. The highest allowable PQL is interchangeable with the lower limit of quantitation, which is the lowest level that can be routinely quantified and reported by a laboratory. MDLs are three to five times lower than quantitation limits.

c. For general chemistry analyses, dilutions for certain ion chromatography constituents may be necessary, potentially raising the PQL above the limits established in this table.

d. For general chemistry analyses, MDLs and PQLs are not strictly determinable. The highest allowable PQLs represent the lowest concentrations that laboratories should be able to measure given current analytical methods and instrumentation.

EPA = U.S. Environmental Protection Agency
MDL = method detection limit
N/A = not applicable
PQL = practical quantitation limit

A3.3 Quality Control

QC requirements specified in the plan must be followed in the field and analytical laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross contamination and to provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, bias, and matrix effects of the analytical data. Field and laboratory QC samples are summarized in Table A-3. Acceptance criteria for field and laboratory QC are shown in Table A-4. Data will be qualified and flagged in HEIS, as appropriate.

Table A-3. Field and Laboratory QC Samples

Sample Type	Frequency	Characteristics Evaluated
Field QC		
Field Duplicates	One in 20 well trips	Precision, including sampling and analytical variability
Field Splits	As needed When needed, the minimum is one for every analytical method, for analyses performed	Precision, including sampling, analytical, and interlaboratory
Full Trip Blanks	One in 20 well trips	Cross-contamination from containers or transportation
Field Transfer Blanks	One each day volatile organic compounds are sampled	Contamination from sampling site
Equipment Blanks	As needed If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment blank is not required; otherwise, one for every 20 samples[a]	Adequacy of sampling equipment decontamination and contamination from nondedicated equipment
Analytical Quality Control [b]		
Laboratory Sample Duplicates	One per analytical batch	Laboratory reproducibility and precision
Matrix Spikes	One per analytical batch	Matrix effect/laboratory accuracy
Matrix Spike Duplicates	One per analytical batch	Laboratory accuracy and precision
Laboratory Control Samples	One per analytical batch	Laboratory accuracy
Method Blanks	One per analytical batch	Laboratory contamination
Surrogates	Added to each sample and QC sample	Recovery/yield

Note: The information in this table does not represent U.S. Environmental Protection Agency requirements but is intended solely as guidance.

a. For portable pumps, equipment blanks are collected one for every 10 well trips. Whenever a new type of nondedicated equipment is used, an equipment blank will be collected each time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination methods for the nondedicated equipment.

b. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater).

QC = quality control

Table A-4. Field and Laboratory QC Elements and Acceptance Criteria

Analyte	QC Element	Acceptance Criteria	Corrective Action
General Chemistry			
Alkalinity	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Flag with "o"[a]
	DUP[b]/MSD[b]	≤20% RPD[c]	Review Data[d]
	MS/MSD	75 to 125% Recovery	Flag with "N"
	EB, FTB	<MDL <5% Sample Concentration	Flag with "Q"
	Field Duplicate	≤20% RPD[c]	Review Data[d]
Anions			
Anions by ion chromatography	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Flag with "o"[a]
	DUP[b]/MSD[b]	≤20% RPD[c]	Review Data[d]
	MS/MSD	75 to 125% Recovery	Flag with "N"
	EB, FTB	<MDL <5% Sample Concentration	Flag with "Q"
	Field Duplicate	≤20% RPD[c]	Review Data[d]
Metals			
Metals by inductively coupled plasma/atomic emission spectrometry	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Flag with "o"[a]
	DUP[b]/MSD[b]	≤20% RPD[c]	Review Data[d]
	MS/MSD	75 to 125% Recovery	Flag with "N"
	EB, FTB	<MDL <5% Sample Concentration	Flag with "Q"
	Field Duplicate	≤20% RPD[c]	Review Data[d]
Hexavalent chromium	MB	<MDL <5% Sample Concentration	Flag with "C"
	LCS	80 to 120% Recovery	Flag with "o"[a]
	DUP[b]/MSD[b]	≤20% RPD[c]	Review Data[d]
	MS / MSD	75 to 125% Recovery	Flag with "N"
	EB, FTB	<MDL <5% Sample Concentration	Flag with "Q"
	Field Duplicate	≤20% RPD[c]	Review Data[d]
Volatile Organic Compounds			
Volatile organics by gas chromatography/mass spectrometry	MB	<MDL <5% Sample Concentration	Flag with "B"
	LCS	70 to 130% Recovery	Flag with "o"[a]
	DUP[b]/MSD[b]	≤20% RPD[c]	Review Data[d]
	MS/MSD	70 to 130% Recovery	Flag with "T"
	SUR	70 to 130% Recovery	Review Data[d]

Table A-4. Field and Laboratory QC Elements and Acceptance Criteria

Analyte	QC Element	Acceptance Criteria	Corrective Action
	EB, FTB, FXR	<MDL <5% Sample Concentration	Flag with "Q"
	Field Duplicate	≤20% RPD[c]	Review Data[d]
Semivolatile Organic Compounds			
Semivolatiles by gas chromatography or gas chromatography/mass spectrometry	MB	<MDL <5% Sample Concentration	Flag with "B"
	LCS	70-130% Recovery	Flag with "o"[a]
	DUP[b]/MSD[b]	≤20% RPD[c]	Review Data[d]
	MS/MSD	% Recovery Statistically Derived[e]	Flag with "T"
	SUR	% Recovery Statistically Derived[e]	Review Data[d]
	EB, FTB	<MDL <5% Sample Concentration	Flag with "Q"
	Field Duplicate	≤20% RPD[c]	Review Data[d]

Notes: The information in this table does not represent EPA requirements, it is intended solely as guidance. The table is consistent with SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*; DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document*, and the EPA/600 Method series.

This table only applies to laboratory analyses. Dissolved oxygen, pH, oxygen reduction potential, temperature, and turbidity are not listed because they are measured in the field.

See Table A-2 for constituent list.

a. Apply with SMR concurrence.

b. Either a DUP or a MSD is to be analyzed to determine measurement precision.

c. Applies when at least one result is greater than the laboratory practical quantitation limit (chemical analyses).

d. After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect ("Y" flag), failed field QC ("Q" flag), or rejected ("R" flag).

e. Laboratory determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

DUP = laboratory sample duplicate
EB = equipment blank
EPA = U.S. Environmental Protection Agency
FTB = full trip blank
FXR = field transfer blank
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
QC = quality control
RPD = relative percent difference
SMR = Sample Management and Reporting
SUR = surrogate

Data Flags:

B, C = possible laboratory contamination: analyte was detected in the associated method blank – laboratory applied.
o = result may be biased: associated laboratory control sample result was outside the acceptance limits – laboratory applied.
N = result may be biased: associated matrix spike result was outside the acceptance limits – laboratory applied.
Q = problem with associated field QC blank: results were out of limits – HEIS review.
T = result may be biased; associated matrix spike result was outside the acceptance limits – laboratory applied.

A3.3.1 Field Quality Control Samples

Field QC samples are collected to evaluate the potential for cross-contamination and provide information pertinent to field sampling variability and laboratory performance to help ensure that reliable data are obtained. Field QC samples include field duplicates, field split (SPLIT) samples, and three types of field blanks (equipment blanks [EBs], field transfer blanks [FXRs], and full trip blanks [FTBs]). Field blanks are typically prepared using high purity reagent water. The following QC sample definitions are detailed with their required frequency:

- **Equipment blanks (EBs):** reagent water passed through or poured over the decontaminated sampling equipment identical to the sample set collected and placed in sample containers, as identified on the SAF. EB sample bottles are placed in the same storage containers with samples from the associated sampling event. EB samples will be analyzed for the same constituents as samples from the associated sampling event. EBs are used to evaluate the effectiveness of the decontamination process, and these samples are not required for disposable sampling equipment.
- **Field duplicates:** independent samples collected as close as possible to the same time and location as the scheduled sample and intended to be identical. Field duplicates are placed in separate sample containers and analyzed independently. Field duplicates are used to determine precision for both sampling and laboratory measurements.
- **Field splits (SPLITs):** two samples collected as close as possible to the same time and location and intended to be identical. SPLITs will be stored in separate containers and analyzed by different laboratories for the same analytes. SPLITs are interlaboratory comparison samples used to evaluate comparability between laboratories.
- **Full trip blanks (FTBs):** bottles prepared by the sampling team before travel to the sampling site. The bottle set is either for volatile organic analysis only or identical to the set that will be collected in the field. It is filled with high purity reagent water,[22] and the bottles are sealed and transported (unopened) to the field in the same storage containers used for samples collected that day. Collected FTBs are typically analyzed for the same constituents as the samples from the associated sampling event. FTBs are used to evaluate potential contamination of the samples attributable to the sample bottles, preservative, handling, storage, and transportation.
- **Field transfer blanks (FXRs):** preserved volatile organic analysis sample vials filled with high-purity reagent water at the sample collection site where volatile organic compounds (VOCs) are collected. Samples will be prepared during sampling to evaluate potential contamination attributable to field conditions. After collection, FXR sample vials will be sealed and placed into the same storage containers with samples collected the same day for the associated sampling event. FXR samples will be analyzed for VOCs only.

A3.3.2 Laboratory Quality Control Samples

Internal QA/QC programs are maintained by laboratories used by the project. Laboratory QA includes a comprehensive QC program that includes the use of laboratory control samples (LCSs), laboratory sample duplicates (DUPs), matrix spikes (MSs), matrix spike duplicates (MSDs), method blanks (MBs), surrogates (SURs). These QC analyses follow EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update V*) and will be run at the frequency specified in Table A-3. QC checks outside of control limits are documented in analytical laboratory reports and during DQAs. Laboratory QC checks and their typical frequencies are listed in

[22] High purity water is generally defined as water that has been distilled, deionized, or undergone any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (DOE/RL-96-68).

Table A-3. Acceptance criteria are presented in Table A-4. Descriptions of the various types of laboratory QC samples are as follows:

- **Laboratory control sample (LCS):** control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.
- **Laboratory sample duplicate (DUP):** an intralaboratory replicate sample that is used to evaluate the precision of a method in a given sample matrix.
- **Matrix spike (MS):** an aliquot of a sample spiked with a known concentration of target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.
- **Matrix spike duplicate (MSD):** a replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.
- **Method blank (MB):** an analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparation and analytical procedure and is used to quantify contamination resulting from the analytical process.
- **Surrogate (SUR):** a compound added to every sample in the analysis batch (field samples and QC samples) prior to preparation. SURs are typically similar in chemical composition to the analyte being determined, but they are not normally encountered. SURs are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because SURs are added to every standard, sample, and QC sample, they are used to evaluate overall method performance in a given matrix. SURs are used only in organic analyses.

Laboratories are required to analyze samples within the holding times specified in Table A-5. In some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, or other chemical changes. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an H.

Table A-5. Preservation and Holding Time Guidelines for Laboratory Analyses

Constituent	Preservation[a]	Holding Time
Alkalinity	Store ≤6°C	14 days
Anions by ion chromatography	Store ≤6°C	48 hours[b]/28 days
Metals by inductively coupled plasma-atomic emission spectrometry	Adjust pH to <2 with nitric acid	6 months
Hexavalent chromium	Store ≤6°C	24 hours
Volatiles by GC/MS	Store ≤6°C, Adjust pH to <2 with hydrochloric acid	14 days
Semivolatiles by GC or GC/MS	Store ≤6°C	7 days before extraction 40 days after extraction

Table A-5. Preservation and Holding Time Guidelines for Laboratory Analyses

Constituent	Preservation[a]	Holding Time

Notes: Information in this table does not represent U.S. Environmental Protection Agency requirements but is intended solely as guidance.

The container type for a sample is available on the chain-of-custody.

This table only applies to laboratory analyses. Dissolved oxygen, pH, oxygen reduction potential, temperature, and turbidity are not listed because they are measured in the field.

See Table A-2 for constituent list.

a. For preservation identified as stored at ≤6°C, the sample should be protected against freezing unless it is known that freezing will not impact the sample integrity.

b. Holding time for nitrate.

G = gas chromatography

GC/MS = gas chromatography/mass spectrometry

A3.4 Measurement Equipment

Each user of the measuring equipment will ensure that equipment is functioning as expected, properly handled, and properly calibrated at required frequencies in accordance with methods governing control of the measuring equipment. Onsite environmental instrument testing, inspection, calibration, and maintenance will be recorded in accordance with approved methods. Field screening instruments will be used, maintained, and calibrated in accordance with manufacturer specifications and other approved methods.

A3.5 Instrument and Equipment Testing, Inspection, and Maintenance

Collection, measurement, and testing equipment should meet applicable standards (e.g., ASTM International, formerly the American Society for Testing and Materials) or should have been evaluated as acceptable and valid in accordance with instrument specific methods, requirements, and specifications. Software applications will be acceptance tested prior to use in the field.

Measurement and testing equipment used in the field or in the laboratory will be subject to preventive maintenance measures to ensure minimization of downtime. Laboratories must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in a QA plan or operating protocols for the individual laboratory and onsite organization, as appropriate. Maintenance of laboratory instruments will be performed consistent with applicable Hanford Site requirements.

A3.6 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Appendix B. Analytical laboratory instruments are calibrated in accordance with the laboratory QA plan and applicable Hanford Site requirements.

A3.7 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed in accordance with test methods in SW-846 and EPA/600 Method series (e.g., EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*), and will be appropriate for their use. Supplies and consumables used in sampling and analysis activities are procured in accordance with internal work requirements and processes. Responsibilities and interfaces necessary to ensure that items procured/acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable specifications. Supplies and consumables are checked and accepted by personnel prior to use.

A3.8 Nondirect Measurements

Data obtained from sources such as computer databases, programs, literature files, and historical records will be technically reviewed to the same extent as data generated as part of any sampling and analysis QA/QC effort. Data used in evaluations will be identified by source.

A3.9 Data Management

The SMR group, in coordination with the Project Delivery Manager for Groundwater Science, is responsible for ensuring that analytical data are reviewed, managed, and stored in accordance with applicable programmatic requirements governing data management methods. Records of data analyses and groundwater surface elevations are maintained as required by 40 CFR 265.94(a)(1), "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," "Recordkeeping and Reporting."

Electronic data access will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b).

Laboratory errors are reported to the SMR group through an established process. For reported laboratory errors, a sample issue resolution form will be initiated in accordance with applicable methods to document analytical errors and establish their resolution with the Project Delivery Manager for Groundwater Science. Sample issue resolution forms become a permanent part of the analytical data package for future reference and records management.

A4 DATA REVIEW AND USABILITY

This chapter addresses QA activities that occur after data collection. Implementation of these activities determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A4.1 Data Review and Verification

Data review and verification are performed to confirm that sampling and chain-of-custody documentation are complete. This review includes linking sample numbers to specific sampling locations, reviewing sample collection dates, sample preparation, and analysis dates to determine if holding times, if any, were met. A QC data review is used to determine if analyses met the data quality requirements specified in this plan.

The criteria for verification include, but are not limited to, review for contractual compliance (samples were analyzed as requested), use of the correct analytical method, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and the correct application of conversion factors. Field QA/QC results also will be reviewed to ensure that they are usable.

The project scientist, assigned by the Project Delivery Manager for Groundwater Science, will perform a data review to determine if observed changes reflect improved/degraded groundwater quality or potential data errors, which may result in a request for data review for questionable data. The laboratory may be asked to check calculations or reanalyze the sample, or the well may be resampled. Results of the request for data review process are used to flag data in the HEIS database and/or add comments.

A4.2 Data Validation

Data validation is performed at the discretion of the Project Delivery Manager for Groundwater Science and under the direction of the SMR group. It is based on the results of QC samples for individual well networks and discussions with the project scientist. If conducted, data validation (third party) will be performed at a minimum frequency of 5% per method and be based on EPA functional guidelines (EPA-540-R-2016-001, *National Functional Guidelines for Inorganic Superfund Data Review* and EPA-540-R-2016-002, *National Functional Guidelines for Superfund Organic Methods Data Review*) and adjusted for use with SW-846 and HASQARD (DOE/RL-96-68).

A4.3 Reconciliation with User Requirements

The DQA process compares completed field sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the DQA is to determine if quantitative data are of the correct type and of adequate quality and quantity to meet the project data quality needs. For routine groundwater monitoring performed through this groundwater monitoring plan, the DQA is captured in the DQA appendix associated with the annual Hanford Site RCRA groundwater report (e.g., DOE/RL-2016-12), which evaluates field and laboratory QC and the usability of data. Further DQAs will be performed at the discretion of the Project Delivery Manager for Groundwater Science and documented in a report overseen by the SMR group.

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APPENDIX B
SAMPLING PROTOCOL

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APPENDIX B
SAMPLING PROTOCOL

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1 **TERMS**

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
FWS	Field Work Supervisor
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Document* (DOE/RL-96-68)
IATA	International Air Transport Association
LERF	Liquid Effluent Retention Facility
NTU	nephelometric turbidity unit
QA	quality assurance
QC	quality control
SMR	Sample Management and Reporting

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B1 INTRODUCTION

Groundwater monitoring at the Hanford Site, as defined by the *Resource Conservation and Recovery Act of 1976* and implemented in WAC 173-303, "Dangerous Waste Regulations," has been conducted since the mid-1980s. Hanford Site groundwater sampling methods contain extensive requirements for sampling precautions; equipment and its use; cleaning and decontamination; records and documentation; and sample collection, management, and control activities. Appendices A and B provide the sampling and analysis essentials for the groundwater monitoring plan: sample collection, sample preservation and holding times, chain-of-custody control, analytical procedures, and field and laboratory quality assurance (QA)/quality control (QC).

This appendix provides specific elements of the sampling protocols and techniques used for the groundwater monitoring plan. Chapter 3 of the monitoring plan identifies the wells that will be sampled, constituents to be analyzed, and sampling frequency for groundwater monitoring at the Liquid Effluent Retention Facility (LERF).

B2 SAMPLING METHODS

Sampling may include, but is not limited to, the following methods:

- Field screening measurements
- Groundwater sampling
- Water level measurements

Groundwater samples will be collected in accordance with the current revision of applicable operating methods, after the following field measurements of purged groundwater have stabilized:

- **pH:** two consecutive measurements agree within ±0.2 pH units
- **Temperature:** two consecutive measurements agree within ±0.2°C (32.3°F)
- **Conductivity:** two consecutive measurements agree within ±10 percent of each other
- **Turbidity:** less than 5 nephelometric turbidity units (NTUs) prior to sampling (or project scientist's recommendation)

Dissolved oxygen will also be measured in the field in this groundwater monitoring plan. Dissolved oxygen and oxygen reduction potential are not indicator parameters, waste constituents, reaction products, nor dangerous constituents and are not required to be stable prior to sample collection.

Unless special requirements are requested from project scientists, wells are typically purged using the equivalent volume as that of three borehole diameter multiplied by the length of the saturated portion of the well screen. Stable field readings are also required (as specified above). The default pumping rate is 7.6 to 45.4 L/min (2 to 12 gal/min), depending on the pump, although pumping at this rate is not practical at every well. When the purge volume is extraordinarily large, wells are purged for a minimum of 1 hour and are then sampled once stable field readings are obtained.

Field measurements (except turbidity) are obtained by pumping groundwater directly from the well to a flow-through cell. At the beginning of the sample event, field crews attach a clean, stainless steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater while the other port supplies water to the flow-through cell. Probes are inserted into the flow-through cell to measure pH, temperature, conductivity, dissolved oxygen, and oxygen reduction potential. Turbidity is measured by inserting a sample vial into a turbidimeter. The purgewater is then discharged to the purgewater truck.

Once field measurements have stabilized, the flow-through cell hose is disconnected, and a clean stainless steel drop leg is attached for groundwater sampling. The flow rate is reduced during sampling to minimize loss of volatiles (if any) and prevent overfilling of the bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles (if any). For some constituents (e.g., metals), both filtered and unfiltered samples are collected: collect the filtered samples after collecting the unfiltered samples. If additional samples require filtration (e.g., turbidity greater than 5 NTUs), an inline disposable 0.45 µm filter is used.

Typically, three traditional types (i.e., Grundfos®, Pacific Hydrostar® and submersible electrical pumps) are used for groundwater sampling at Hanford Site monitoring wells. Low purge volume, adjustable rate bladder pumps may also be used. Pumps are selected based on the unique characteristics of the well and the sampling requirements.

Some wells at the Hanford Site cannot support pumping of samples because of low yield or physical characteristics of the well. In these cases, a grab sample may be obtained. In cases where there is not sufficient yield, purgewater activities are not performed.

Low purge volume sampling methods are also being implemented at the Hanford Site. Low flow purging and sampling uses a low purge volume, adjustable rate bladder pump with typical flow rates of 0.1 to 0.5 L/min (0.026 to 0.13 gal/min). This method minimizes movement of groundwater from the soil formation into the well. The objective is to pump in a manner that minimizes stress (drawdown) to the system. Purge volumes for wells using low purge bladder pumps are determined on a well specific basis based on drawdown, pumping rate, pump and sample line volume, and volume required to obtain stable field conditions prior to sampling.

Preservatives are required for certain types of samples. Preservatives, based on the analytical methods used, are added to the collection bottles before their use in the field. Samples may require filtering in the field, as noted on the chain-of-custody form.

To ensure sample and data usability, sample collection, collection equipment, and sample handling under this groundwater monitoring plan will be performed according to the requirements of DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document* (HASQARD).

Sample preservation and holding time requirements are specified for groundwater samples in Appendix A (Table A-5) in accordance with the analytical method specified in (Table A-2). Container types, preservatives, and volumes will be identified on the chain-of-custody form. This groundwater monitoring plan defines a sample as a filled sample bottle for purposes of starting the clock for holding time restrictions.

Holding time is the maximum allowable period between sample collection and analysis. Exceeding required holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Holding times depend on the constituents and are listed in analytical method compilations, such as APHA/AWWA/WEF, 2012, *Standard Methods for the Examination of Water and Wastewater*, SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Third Edition; Final Update V*, and the EPA/600 Method series (e.g., EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*). Recommended holding times are also provided in HASQARD (DOE/RL-96-68) and in applicable laboratory contracts.

® Grundfos is a registered trademark of Grundfos Pumps Corporation, Downers Grove, Illinois.

® Hydrostar is a registered trademark of KYB Corporation, Tokyo, Japan.

B2.1 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated in accordance with decontamination methods. To prevent potential sample contamination, care should be taken to use decontaminated equipment for each specific sampling activity.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

Decontamination of sampling equipment and pumps is performed using high purity water[1] in each step. In general, three rinse cycles are performed to decontaminate sampling equipment: detergent rinse, acid rinse, and water rinse. During the detergent rinse, equipment is washed in a phosphate-free detergent solution, followed by rinsing with water in three sequential containers. After the third water rinse, equipment that is stainless steel or glass is rinsed in a 1M nitric acid solution (pH less than 2). Equipment is then rinsed with water in three sequential containers (the water rinses following the acid rinse are conducted in separate water containers that are not used for detergent rinse). Following the final water rinse, equipment is rinsed in hexane and placed on a rack to dry. Dry equipment is loaded into a drying oven. The oven is set at 50°C (122°F), for items that are not metal or glass, or at 100°C (212°F) for metal or glass. Once reaching temperature, equipment is baked for 20 minutes and then cooled. Equipment is then removed from the oven, wrapped in clean unused aluminum foil, and stored in a custody-locked, controlled access area.

To decontaminate sampling pumps that are not permanently installed, the pump cowling is first removed, washed (if needed) in phosphate-free detergent solution, and then reinstalled on the pump. The pump is then submerged in phosphate-free detergent solution and 11.4 L (3 gal) of solution are pumped through the unit and disposed. Detergent solution is then circulated through the submerged pump for 5 minutes. The pump is removed from solution and rinsed with water. The pump is submerged in water and 30.3 L (8 gal) of water are pumped through the unit and disposed. The pump is removed from the water, and the intake and housing are covered with plastic sleeving. Cleaning is documented on a tag that is affixed to the pump with the following information:

- Date of pump cleaning
- Pump identification
- Comments
- Signature of person performing decontamination

B2.2 Water Levels

Each time a sample is obtained, a measurement of the groundwater surface elevation at each monitoring well is required by WAC 173-303-645(8)(f), "Releases from Regulated Units," "General Groundwater Monitoring Requirements." Using a calibrated depth measurement tape, the depth to water is recorded for

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[1] High purity water is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques (HASQARD [DOE/RL-96-68]).

each well prior to sampling. When two consecutive measurements agree within 6 mm (0.24 in.), the final determined measurement is recorded, along with the date and time for the specific event. The depth to groundwater is subtracted from the elevation of a reference point (usually the top of casing) to obtain the water level elevation. The top of casing is a known elevation reference point because it has been surveyed to local reference data.

B3 DOCUMENTATION OF FIELD ACTIVITIES

Logbooks or data forms are required for field activities and will be used in accordance with HASQARD (DOE/RL-96-68). A logbook must be identified with a unique project name and number. The individual(s) responsible for the logbook will be identified in the front of the logbook. Only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the sampling Field Work Supervisor (FWS), cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous entry with a single line, entering the correct information or data, and initialing and dating the changes.

Data forms may be used to collect field information; however, information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks or on data forms is as follows:

- Day and date; time task started; weather conditions; and names, titles, and organizations of personnel performing the task
- Purpose of visit to the task area
- Site activities in specific detail (e.g., maps and drawings) or the forms used to record such information (e.g., soil boring log or well completion log), details of any field tests conducted, references to any forms that were used, other data records, and methods followed for the activity
- Details of any field calibrations and surveys conducted, reference to any forms used, other data records, and methods followed for the calibrations and surveys
- Details of any samples collected and the preparation (if any) of splits, duplicates, matrix spikes, or blanks (reference the methods followed to collect or prepare samples, sample locations, sample types, labels or tag numbers, sample identification, sample containers and volume, preservation method, packaging, chain-of-custody form number, and analytical request form number pertinent to each sample or sample set; and note the time and the name of the individual accepting custody of samples)
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed (reference the page number[s] of any logbook where detailed information is recorded)
- Any equipment failures or breakdowns, with a brief description of repairs or replacements

B3.1 Corrective Actions and Deviations for Sampling Activities

The Project Delivery Manager for Groundwater Science, FWS, appropriate field crew supervisors, and Sample Management and Reporting (SMR) personnel must document deviations from protocols, issues pertaining to sample collection, chain-of-custody forms, target analytes, contaminants, sample transport, and noncompliant monitoring. Examples of deviations include samples not collected due to field conditions.

Deviations or issues will be documented (e.g., in the field logbook) in accordance with internal corrective action methods. The Project Delivery Manager for Groundwater Science, FWS, field crew supervisors, or

SMR personnel will be responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

B4 CALIBRATION OF FIELD EQUIPMENT

Onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records will include the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. The results from all instrument calibration activities are recorded in accordance with HASQARD requirements (DOE/RL-96-68).

Field instrumentation calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system
- At the frequency recommended by the manufacturer or methods, or as required by regulations
- Upon failure to meet specified QC criteria
- Daily calibration checks that will be performed and documented for each instrument used (these checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data; analysis times will be sufficient to establish detection efficiency and resolution)
- Using standards for calibration that are traceable to a nationally recognized standard agency source or measurement system (manufacturer's recommendations for storage and handling of standards, if any, will be followed)

B5 SAMPLE HANDLING

Sample handling and transfer will be in accordance with established methods to preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape, inscribed with the sampler's initials and date, will be used to verify that sample integrity has been maintained during transport.

A sampling and analytical database is used to track samples from the point of collection through the laboratory analysis process.

B5.1 Containers

Samples will be collected, where and when appropriate, in break-resistant containers. The field sample collection record will indicate the manufacturer's lot number of the bottles used in sample collection. When commercially pre-cleaned containers are used in the field, the name of the manufacturer, lot identification, and certification will be retained for documentation.

Contaminated sample containers cannot be used for a sampling event. Containers will be capped and stored in an environment that minimizes the possibility of contamination. If contamination of the stored sample containers occurs, corrective actions will be implemented to prevent reoccurrences. Container sizes may vary depending on laboratory specific volumes/requirements for meeting analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

B5.2 Container Labeling

Each sample is identified by a standardized label or tag attached to the container. This label or tag will include the sample identification number. The label will identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis required, and collector's name or initials. Sample labels may be preprinted or handwritten in indelible or waterproof ink.

B5.3 Sample Custody

Sample custody will be maintained in accordance with existing protocols to ensure that sample integrity is maintained throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sample collection and will accompany each set of samples shipped to any laboratory.

The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, new and previous custodians will sign the record and note the date and time. The field sampling team will make a copy of the signed record before sample shipment and transmit the copy to the SMR group. The following minimum information is required on a completed chain-of-custody form:

- Project name
- Collectors' names
- Unique sample number
- Date, time, and location (or traceable reference thereto) of collection
- Matrix
- Preservatives
- Chain-of-possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody, storage locations, and dates/times of receipt and relinquishment)
- Requested analyses (or reference thereto)
- Shipped to information (i.e., analytical laboratory performing the analysis)

Samplers should note any sample anomalies. If anomalies are found, samplers should inform the SMR group, so special direction for analysis can be provided to the laboratory, if necessary.

B5.4 Sample Transportation

Packaging and transportation instructions will comply with applicable transportation regulations and U.S. Department of Energy (DOE) requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT) as described in 49 CFR 171, "Transportation," "General Information, Regulations, and Definitions," through 49 CFR 177, "Carriage by Public Highway."[2] Carrier specific requirements, defined in the current edition of the International Air Transport Association (IATA) *Dangerous Goods Regulations*, will also be used when preparing sample shipments conveyed by air freight.

[2] Transportation regulations 49 CFR 174, "Carriage by Rail," and 49 CFR 176, "Carriage by Vessel," are not applicable because those two transportation methods are not used.

Samples containing hazardous constituents will be considered hazardous material in transportation and transported according to DOT/IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material. Appropriate laboratory notifications will be made, if necessary, through the SMR project coordinator.

B6 MANAGEMENT OF WASTE

Waste materials are generated during sample collection, processing, and subsampling activities. Waste will be managed in accordance with DOE/RL-2003-30, *Waste Control Plan for the 200-BP-5 Operable Unit*. For waste designation purposes, data for wells listed in Table D-7 in the main text of the monitoring plan may be surveyed in the Hanford Environmental Information System, and the maximum concentration for each analyte within the most recent 5 years will be evaluated for use in creating a waste profile, if required.

Miscellaneous solid waste that has contacted suspect dangerous waste will be managed as dangerous waste. Purgewater and decontamination fluids will be collected and managed in accordance with DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*, and DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*. Waste materials requiring collection will be placed in containers appropriate for the material and the receiving facility in accordance with the applicable waste management or waste control plan and applicable substantive federal and/or state requirements.

Packaging and labeling during waste storage and transportation will meet WAC 173-303 and DOT requirements, as appropriate. Packaging exceptions to DOT requirements may be used for onsite shipments if documented as such and if the packaging provides an equivalent degree of safety during transportation.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities.

B7 HEALTH AND SAFETY

DOE established the hazardous waste operations safety and health program pursuant to the *Price-Anderson Amendments Act of 1988* to ensure the safety and health of workers involved in mixed waste site activities. The program was developed to comply with the requirements of 10 CFR 851, "Worker Safety and Health Program," which incorporates the standards of 29 CFR 1910.120, "Occupational Safety and Health Standards," "Hazardous Waste Operations and Emergency Response;" 10 CFR 830, "Nuclear Safety Management;" and 10 CFR 835, "Occupational Radiation Protection." The health and safety program defines the chemical, radiological, and physical hazards and specifies the controls and requirements for daily work activities on the Hanford Site. Personnel training; control of industrial safety and radiological hazards; personal protective equipment; site control; and general emergency response to spills, fire, accidents, injury, site visitors, and incident reporting are governed by the health and safety program.

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APPENDIX C
WELL CONSTRUCTION

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APPENDIX C
WELL CONSTRUCTION

TABLE OF CONTENTS

FIGURES

TABLES

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C1 INTRODUCTION

This appendix provides the following information for the Liquid Effluent Retention Facility groundwater monitoring wells:

- Well name
- Hydrogeologic unit to be monitored (the portion of the aquifer that is located at the well screen or perforated casing) (Table C-1)
- The following sampling interval information, as shown in Table C-2:
  - Elevation at top of the screen or perforated interval
  - Elevation at the bottom of the screen or perforated interval
  - Water remaining in saturated screen (i.e., difference between elevations of top and bottom of the screen or perforated interval)

Figures C-1 through C-7 provide well construction and completion summaries of the three Liquid Effluent Retention Facility wells.

Table C-1. Hydrogeologic Monitoring Unit Classification Scheme

Unit	Description
TB	**Top of Basalt.** Open to less than 9.1 m (30 ft) within the top of basalt.
TU	**Top of Unconfined.** Screened across the water table or the top of the open interval is within 1.5 m (5 ft) of the water table, and the bottom of the open interval is no more than 10.7 m (35 ft) below the water table.

Table C-2. Sampling Interval Information for Wells within the Liquid Effluent Retention Facility Network

Well Name	Hydrogeologic Unit Monitored	Water Table Elevation (m [ft] NAVD88)[a]	Elevation Top of Screen (m [ft] NAVD88)	Elevation Bottom of Screen (m [ft] NAVD88)	Water Remaining Saturated Screen Interval (m [ft])
299-E26-14	TU	121.8 (399.606)	122.784 (402.834)	116.688 (382.834)	5.04 (16.54)
299-E26-15	TU	121.734 (399.39)[b]	124.163 (407.358)	119.484 (392.008)	2.25 (7.38)
299-E26-79	TU/TB	121.74 (399.409)	122.859 (403.081)	115.239 (378.081)	6.501 (21.33)

Reference: NAVD88, *North American Vertical Datum of 1988*.

a. Water elevation is based on uncorrected barometric measurements on 5/23/2016.

b: Water elevation is based on corrected barometric measurements on 5/23/2016.

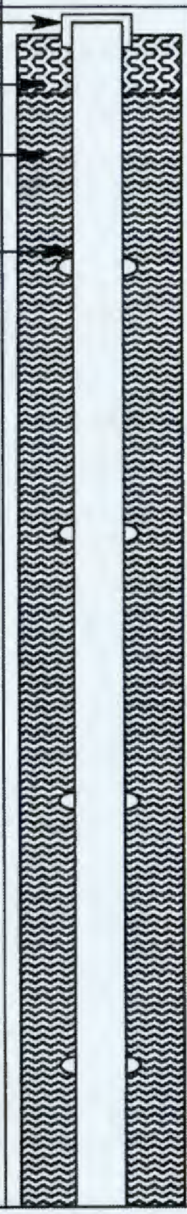
Note: See Table D-4 in main text for additional well attributes.

TU = Top of Unconfined, as described in Table C-1

TB = Top of Basalt, as described in Table C-1

WELL SUMMARY SHEET	Start Date: 9/8/11 Finish Date: 9/27/11	Page 1 of 2
Well ID: C8204	Well Name: 299-E26-14	
Location: 250 meters south of LERF Facility	Project: 2 M-24 RCRA Groundwater Wells	
Prepared By: Patrick Cabbage — Date: 10/20/11	Reviewed By: DC Weekes	Date: 10/24/11
Signature: Patrick Cabbage	Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
Stainless Steel Protective Casing: 2.88 ft above ground surface Type I/II Portland Cement Grout: 0 - 9.2 ft bgs #8 Granular Bentonite Crumbles: 9.2 - 187.3 ft bgs 4-in I.D., Schedule 10, Type 304, Stainless Steel Permanent Casing: 1.79 ft ags - 195.90 ft bgs All temporary drill casing was removed from the ground. All depths are in feet below ground surface. The borehole was drilled with 10 ¾-inch O.D. casing from 0.0 - 100.6 ft bgs, with 8 ¾-inch O.D. casing from 100.6 - 220.7 ft bgs, and with open hole from 220.7 to 240.6 ft bgs.	

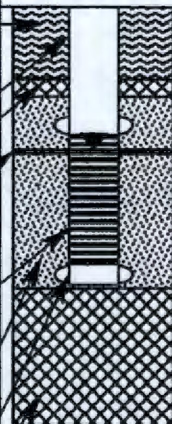
GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-1 Gravel Drill Pad (G)
		1-34 Silty Sandy Gravel (msG)
20		
		34-36 Sandy Gravel (sG)
		36-45 Sand (S)
40		
		45-57 Gravelly Sand (gS)
60		57-77 Sandy Gravel (sG)
80		77-83 Sandy Gravel (sG)
		83-98 Sandy Gravel (sG)
100		98-103 Gravelly Sand (gS)
		103-106 Gravelly Sand (gS)
		106-122 Sandy Gravel (sG)
120		122-177 Sandy Gravel (sG)
140		
160		

Figure C-1. Well 299-E26-14 Summary Sheet

WELL SUMMARY SHEET		Start Date: 9/8/11 / Finish Date: 9/27/11	Page 2 of 2
Well ID: C8204		Well Name: 299-E26-14	
Location: 250 meters south of LERF Facility		Project: 2 M-24 RCRA Groundwater Wells	
Prepared By: Patrick Cabbage	Date: 10/21/11	Reviewed By: DC Weekes	Date: 10/24/11
Signature: Patrick Cabbage		Signature: DC Weekes	

CONSTRUCTION DATA

Description	Diagram
#8 Granular Bentonite Crumbles: 9.2 - 187.3 ft bgs	
4-in I.D., Schedule 10, Type 304, Stainless Steel Permanent Casing: 1.79 ft ags - 195.90 ft bgs	
3/8-in Bentonite Pellets: 187.3 - 190.0 ft bgs	
Static Water Level: 198.4 ft bgs (9/27/11)	
4-in I.D., Schedule 10, Type 304, Stainless Steel 20-slot Screen: 195.90 - 215.90 ft bgs	
Primary Filter Pack 10-20 Mesh Colorado Silica Sand: 190.0 - 219.6 ft bgs	
4-in I.D., Schedule 10, Type 304, Stainless Steel Sump: 215.90 - 218.90 ft bgs	
3/8-in Bentonite Pellets: 219.6 - 240.6 ft bgs	

All temporary drill casing was removed from the ground.

All depths are in feet below ground surface.

The borehole was drilled with 10 ¾-inch O.D. casing from 0.0 - 100.6 ft bgs, with 8 ¾-inch O.D. casing from 100.6 - 220.7 ft bgs, and with open hole from 220.7 to 240.6 ft bgs.

GEOLOGIC/HYDROLOGIC DATA

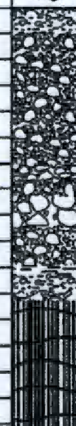
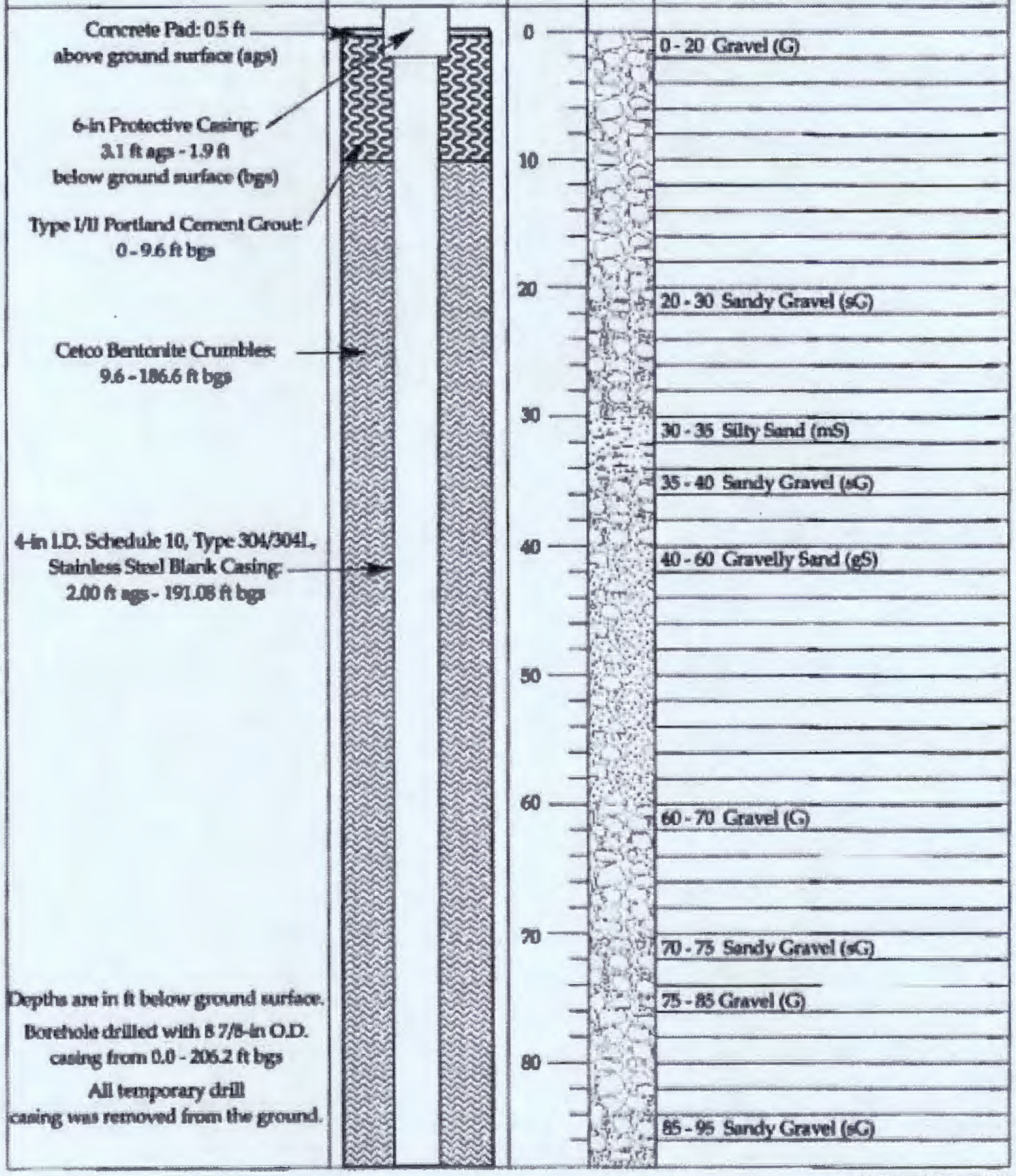
Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
180		177-180 Silty Gravel (mG)
		180-200 Silty Sandy Gravel (msG)
200		200-202.5 Gravel (G)
		202.5-205 Silty Sandy Gravel (msG)
		205-210 Gravel (G)
		210-215.5 Sandy Gravel (sG)
		215.5-217 Silt (M)
220		217-220 Gravelly Silt (gM)
		220-221 Silty Gravel (mG)
		221-240.6 Basalt
240		TD = 240.6 ft bgs (09-21-2011)
260		

Figure C-2. Well 299-E26-14 Summary Sheet (Continued)

WELL SUMMARY SHEET		Start Date: 5/19/2015 Finish Date: ~~6/12/2015~~ 6/16/15	Page 1 of 3
Well ID: C8913		Well Name: 299-E26-15	
Location: 20 m S of catch basin 242AL-43		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 6/12/15	Reviewed By: J.D. [illegible] Environmental Scientist	Date: 7-2
Signature:		Signature:	
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet / Graphic Log	Lithologic Description (ft bgs)



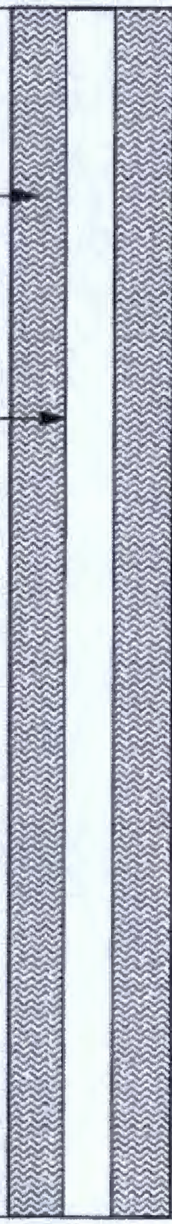
A-6003-643 (REV 1)

Figure C-3. Well 299-E26-15 Summary Sheet

WELL SUMMARY SHEET		Start Date: 5/19/2015 Finish Date: ~~6/12/2015~~ 6/16/15 AEL 6/16/15	Page 2 of 3
Well ID: C8913		Well Name: 299-E26-15	
Location: 20 m S of catch basin 242AL-43		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 6/12/15	Reviewed By: L. MEHRER	Date: 7-22
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 9.6 - 186.6 ft bgs	
4-in I.D. Schedule 10, Type 304/304L, Stainless Steel Blank Casing: 2.00 ft ags - 191.08 ft bgs	
Depths are in ft below ground surface.	
Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 206.2 ft bgs	
All temporary drill casing was removed from the ground.	



GEOLOGIC/HYDROLOGIC DATA

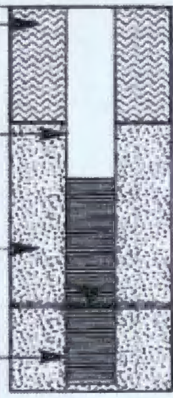
Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
90		85 - 95 Sandy Gravel (sG)
		95 - 190 Gravel (G)
100		
110		
120		
130		
140		
150		
160		
170		

A-6003-643 (REV 1)

Figure C-4. Well 299-E26-15 Summary Sheet (Continued)

WELL SUMMARY SHEET		Start Date: 5/19/2015 Finish Date: ~~6/12/2015~~ 6/16/15	Page 3 of 3
Well ID: C8913		Well Name: 299-E26-15	
Location: 20 m S of catch basin 242AL-43		Project: 8 M24 TPA GW Monitoring Wells FY2015	
Prepared By: Jessa Szecsody	Date: 6/12/15	Reviewed By:	Date: 7-2?
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Cetco Bentonite Crumbles: 9.6 - 186.6 ft bgs 4-in I.D. Schedule 10, Type 304/304L Stainless Steel Blank Casing: 2.00 ft ags - 191.08 ft bgs 10-20 mesh Premier Colorado Silica Filter Pack Sand: 186.6 - 206.9 ft bgs 4-in I.D. Schedule 10, Type 304/304L, 30-slot (0.030 in.) Stainless Steel Screen: 191.08 - 206.43 ft bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
180		95 - 190 Gravel (G)
190		190 - 208 Sandy Gravel (sG)
200		Static Water Level: 200.4 ft bgs (05/20/15) Total Depth: 206.9 ft bgs (05/20/15)
210		
220		
230		
240		
250		
260		

Depths are in ft below ground surface

Borehole drilled with 8 7/8-in O.D. casing from 0.0 - 206.2 ft bgs

All temporary drill casing was removed from the ground.

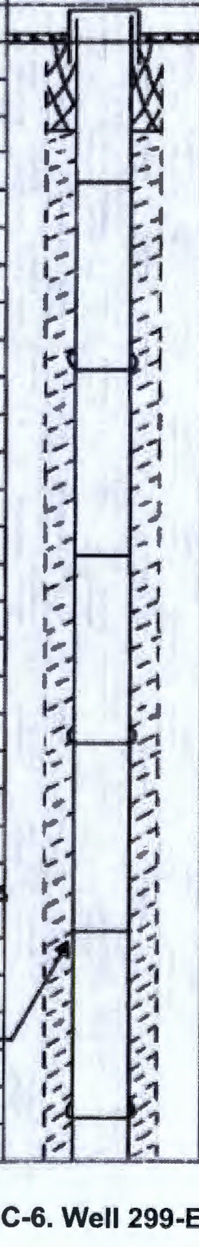
A-6003-643 (REV 1)

Figure C-5. Well 299-E26-15 Summary Sheet (Continued)

WELL SUMMARY SHEET	Start Date: 09/07/2008 Finish Date: 10/02/2008	Page 1 of 2

Well ID: C6826	Well Name: 299-E26-79
Location: Inside fence, LERF, 200E	Project: M-24 RCRA Wells (LERF)
Prepared By: S. Sexton Date: 10/6/08	Reviewed By: L.D. Walker Date: 10/13/08
Signature: [illegible]	Signature: [illegible]

CONSTRUCTION DATA

Description	Diagram
6' x 4' x 4' concrete pad 6" stainless steel protective monument: 3.0' bgs to 3.1' ags 4" stainless steel Sch. 10 casing: 2.3 ft ags to 195.2 ft bgs 4" stainless steel wire wrap screen, 0.020": 195.2 to 220.2' bgs 4" stainless steel Sch. 10 sump: 220.2 to 223.2 ft bgs Portland cement grout: 0 to 10.3 ft bgs Bentonite granules: 10.3 to 183.0 ft bgs Bentonite pellets: 183.0 to 187.8 ft bgs 10-20 silica sand: 187.8 to 224.76 ft bgs Casing joint	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0-1: gravel drill pad 1-27: sandy silty Gravel (smG)
20		27-27.5: sandy Silt (sM) 27.5-29: silty Gravel (mG) 29-32: sandy Silt (sM) 32-54: silty Sand (mS)
40		
60		54-79: silty sandy Gravel (msG)
80		79-119: sandy silty Gravel (smG)
100		

A-6003-643 (03/03)

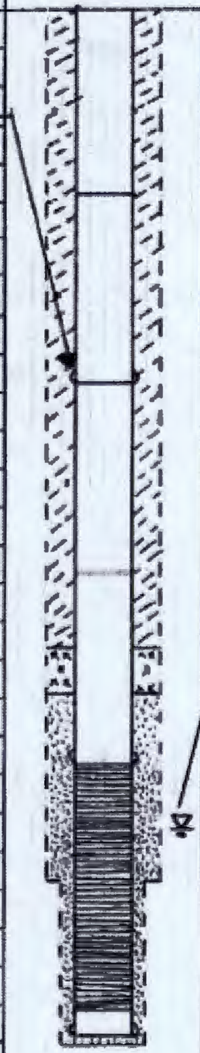
Figure C-6. Well 299-E26-79 Summary Sheet

WELL SUMMARY SHEET		Start Date: 09/09/2008 Finish Date: 10/02/2008	Page 2 of 2
Well ID: C6826	Well Name: 299-E26-79		
Location: Inside Fence, LCRF, 200E	Project: M-24 RCRA Wells (LERF)		
Prepared By: S. Sexton	Date: 10/6/08	Reviewed By: L. D. Walker	Date: 10/13/08
Signature:		Signature:	

CONSTRUCTION DATA — Description | Diagram

Centralizer

All temporary casing removed from borehole



GEOLOGIC/HYDROLOGIC DATA — Depth in Feet | Graphic Log | Lithologic Description

Depth markers: 120, 140, 160, 180, 200, 220

115-135: silty sandy Gravel (msG)

135-152: Gravel (G)

152-200: silty sandy Gravel

DTW = 201.7 ft bgs on 09/22/2008

200-203: sandy Gravel (sG)

203-206: gravelly Sand (gS)

206-207: mottled clay

207-224.76: basalt

TD = 224.76 ft bgs on 09/23/2008

All depths recorded in feet below ground surface (bgs)

A-6003-643 (03/03)

Figure C-7. Well 299-E26-79 Summary Sheet (Continued)

C2 REFERENCE

NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Spring, Maryland. Available at: http://www.ngs.noaa.gov/.

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LIQUID EFFLUENT RETENTION FACILITY (LERF) & 200 AREA EFFLUENT TREATMENT FACILITY (ETF) ADDENDUM H CLOSURE PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/25/2017	8C.2017.3F
08/25/2016	8C.2016.Q2

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ADDENDUM H
CLOSURE PLAN

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ADDENDUM H
CLOSURE PLAN

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H. CLOSURE PLAN

This addendum describes the planned activities and performance standards for closing Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF). Additionally, Section H.5.2.1 presents isolation actions to be implemented for Load-In Station Tanks 59A-TK-109 and 59A-TK-117 prior to completing closure activities as part of the LERF and 200 Area ETF closure.

H.1 Closure Plan

The LERF and 200 Area ETF will be closed by removal or decontamination with respect to dangerous waste contamination that resulted from operation as Treatment, Storage, and Disposal (TSD) units, with closure of LERF occurring first. To facilitate closure, the LERF retention basins are being viewed as consisting of seven components: the covers and primary liner, drainage layer system/bentonite carpet liner, secondary liner, soil/bentonite, internal and/or external piping, ancillary equipment, and concrete basins. To facilitate closure of 200 Area ETF, the 200 Area ETF is being viewed as consisting of six components: tanks, internal and/or external piping, ancillary equipment, concrete floors/dikes/ encasements, structures, and soil directly beneath the structure. If it is determined that closure by removal or decontamination is not possible, the closure plan will be modified to address required post closure activities.

Uncontaminated structures will be left for future use or disassembled, dismantled, and removed for disposal. Uncontaminated equipment and structures could include aqueous makeup, HVAC and piping, steam condensate and cooling water piping, and the 200 Area ETF Control Room and office areas.

Closure by removal or decontamination requires decontamination or removal and disposal of all dangerous waste, waste residues, contaminated equipment, soil, or other material established in accordance with the removal or decontamination closure performance standards of WAC 173-303-610(2). This and future closure plan revisions will provide for compliance with these performance standards.

H.2 Closure Performance Standard

Closure by removal or decontamination, as provided for in this plan based on the requirements of WAC 173-303-610(2), will eliminate future maintenance and will be protective of human health and the environment by removing or reducing chemical contamination at LERF and 200 Area ETF to levels that are below concern with respect to human health and the environment.

This plan proposes to leave clean structures and equipment in place after closure for potential use in future operations. This need will be evaluated at the time of closure.

H.2.1 Closure Standards for Metal Surfaces, Rubber, Tanks, and Concrete

This closure plan proposes use of a 'clean debris surface' (defined in the following paragraph) as the clean closure performance standard for the metal surfaces, rubber (i.e., basin covers, liners, etc.), tanks, and concrete that will remain after closure. This approach is consistent with the Washington State Department of Ecology (Ecology) guidance (Publication #94-111, Ecology 2005) for achievement of clean closure. Additionally, adherence to this guidance ensures that all residues have been removed as required by WAC 173-303-640 for closure of the 200 Area ETF tank systems.

The clean debris surface standard is verified visually.

> *A clean debris surface means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except residual staining from soil and waste consisting of light shadows, slight streaks, or minor discolorations and soil and waste in cracks, crevices, and pits may be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to no more than 5% of each square inch of surface area* (40 CFR 268.45).

When a physical extraction method is used on concrete, the performance standard is based on removal of the contaminated layer of debris. The physical extraction performance standard for concrete is removal of

0.25 inches of the surface layer and treatment to a clean debris surface. Inspections to verify achievement of a clean debris surface will be performed and documented.

H.2.2 Closure Standards for Piping and Ancillary Equipment

The internal and external piping of both LERF and 200 Area ETF that has contacted dangerous waste will be flushed and drained as part of closure. When practical, ancillary equipment, which has contacted dangerous waste will also be flushed and drained. For piping and ancillary equipment where the contaminated surfaces can be inspected, an inspection will be performed to see if the surfaces meets the clean debris surface standard in 40 CFR 268.45, incorporated by reference by WAC 173-303-140, and can be declared non-dangerous in accordance with WAC 173-303-071(3)(qq). If it is not possible to inspect the contaminated surfaces or meet the clean debris surface performance standard, the particular piping or ancillary equipment of concern will be removed, designated, and disposed of accordingly.

Dangerous and/or mixed-waste materials generated during closure activities will be managed in accordance with WAC 173-303-610(5). Removal of any dangerous wastes or dangerous constituents during partial or final closure will be handled in accordance with applicable requirements of WAC 173-303-610(5).

H.2.3 Closure Standards for Underlying Soils

The LERF retention basins have a leachate collection system that channels the leachate to sumps at the bottom of the basins. The collected liquid is pumped back into the basins, thereby limiting fluid head on the secondary liner. The secondary liner is comprised of several protective layers, including a high-density polyethylene geomembrane and a soil/bentonite admixture. The soil below the LERF only could be contaminated if the layers of the secondary liner had failed. The primary liner and the drainage gravel, geotextile, and geonet between the primary and secondary liners cannot easily be decontaminated. The high-density polyethylene layer of the secondary liner also cannot be decontaminated. These materials will be removed and disposed according to the requirements of WAC 173-303-170. The soil/bentonite admixture will be sampled and analyzed for constituents of concerns according to the sampling and analysis plan developed prior to the time of closure. If the analytical results determine that the constituents of concern are at or below the levels in WAC 173-303-610(2)(b)(i), or background levels for Hanford soil if background is greater, the soil/bentonite admixture and the soil below LERF will be considered clean closed.

Clean closure of soil under the 200 Area ETF will be accomplished by demonstrating that the coated concrete floor kept contaminants from reaching the soil. The coated concrete floor provided secondary containment for all the tanks and process piping. Unless inspections identify potential through-thickness cracks indicating containment failure and a subsequent potential for soil contamination from TSD unit operations, the soil will be considered clean closed. However, if inspections identify such cracks and there have been documented spills in the vicinity, potential soil contamination will be investigated. Soils will be sampled and analyzed for constituents of concern according to the sampling and analysis plan. The sampling and analysis plan will be prepared following the completion of a data quality objectives process in accordance with EPA/600/R-96/055 (QA/G-4), *Data Quality Objectives Process*, as amended. The data quality objectives process will be initiated prior to closure on a schedule to ensure timely closure of LERF. The sampling and analysis plan will be submitted to Ecology as part of a permit modification request meeting the requirements of WAC 173-303-830. The sampling and analysis plan will be prepared consistent with EPA/240/B-01/003 (EPA QA/R-5), *EPA Requirements for Quality Assurance Project Plans*, as amended.

If the soil analytical results determine that the constituents of concern are at or below the levels in WAC 173-303-610(2)(b)(i), or background levels in the Hanford soil if background is greater, the soil will be considered clean closed. If the constituents of concern exceed background levels, the soil will be closed per the standards of WAC 173-303-610(2)(b).

H.3 Closure Activities

At the time of closure, the closure plan will be modified as necessary to reflect current regulation or informational revisions in accordance with WAC 173-303-610(3)(b). If it is determined that clean closure is not possible, the closure plan will be modified to address required post closure activities.

H.3.1 General Closure Activities

The approach to LERF closure is to dispose of accumulated basin aqueous waste by processing the waste through 200 Area ETF. Primary basin liners, covers, drainage gravel, geonets, and secondary High Density Polyethylene (HDPE) liners will be removed, designated, and disposed of as described in Sections H.3.4.1 and H.3.4.2. Any remaining solids (residue) within the basins will also be removed, designated, and disposed of accordingly. Piping associated with LERF closure is intended to be decontaminated, drained, and inspected. Piping that meets the closure standard in Section H.2.2 will be left in place. Piping that does not meet the closure standard, or cannot be inspected, will be disposed of accordingly. Rinsate generated during decontamination also will be disposed of through 200 Area ETF. Sampling will assess whether contamination beneath the secondary HDPE liner has occurred. Contamination above background levels, if present, will be removed or decontaminated to meet the regulatory requirements of WAC 173-303-610(2)(b).

The approach to 200 Area ETF closure is to process any aqueous waste through the effluent treatment system. Any waste, which cannot be treated at 200 Area ETF as the facility is being closed, will be transferred to other TSD units or off-site TSD facility. Piping will be rerouted and temporary piping installed to allow the isolation of tanks and ancillary equipment for draining, decontamination, and closure. Rerouted and temporary piping will be closed in the same manner as process piping. All structures and equipment will be decontaminated to the closure standards in Section H.2.2 or disposed. Piping associated with 200 Area ETF closure is intended to be decontaminated, drained, and inspected. Piping that meets the closure standard in Section H.2.2 will be left in place. Piping that does not meet the closure standard, or cannot be inspected, will be disposed of accordingly. Contamination, if present, will be managed in compliance with regulatory requirements.

Equipment or materials used in performing closure activities will be decontaminated or disposed at a permitted facility.

H.3.2 Constituents of Concern for Closure for the Liquid Effluent Retention Facility and 200 Area Effluent Treatment Facility

Using the list of dangerous waste numbers in the Addendum A, Part A Form, constituents in the final delisting in 40 CFR 261 Appendix IX, sample results from wastes added to LERF and 200 Area ETF, process knowledge and the risk to human health and the environment, the constituents of concern for closure will be determined through the data quality objective process. Based on constituents in wastewater received at LERF from 2000 to 2006 which are present at five percent of their delisting levels or higher, the constituents of concern are:

- Acetone
- Ammonia
- Barium
- Chromium
- Carbon tetrachloride
- Fluoride
- Lead
- Mercury
- Methyl ethyl ketone
- n-Butyl alcohol
- Total cresols
- Tributyl phosphate
- Vanadium

Arsenic and beryllium are excluded because they are present in Hanford soils and may therefore give a false positive sample result. Constituents of concern vary in each basin. For example, ammonia may be present only in LERF Basin 42. The constituents of concern for each basin will be determined by process knowledge as part of the Data Quality Objectives process for the Sampling and Analysis Plan.

H.3.3 Removing Dangerous Waste

At the start of LERF closure, aqueous waste will be transferred sequentially from each basin to another LERF basin or to 200 Area ETF for treatment.

At a pump rate of about 75 gallons per minute, it will take approximately 60 days to empty a full basin. Basin covers will remain in place to prevent possible wind dispersion of waste until all basin waste has been removed.

All of the aqueous waste inventory at the 200 Area ETF will be processed before closure. Any residue remaining in piping, equipment, or the LERF liner will be removed to an appropriate disposal unit. All containerized waste will be dispositioned. All secondary waste in containers will be transferred to an appropriate TSD unit.

H.3.4 Decontaminating Structures, Equipment, and Soils

This section discusses the activities necessary to implement a clean closure strategy for the LERF and 200 Area ETF.

H.3.4.1 Covers and Primary Liner

The following steps will be performed to close each LERF basin cover and primary liner:

- Wastewater will be removed from the basins and transferred to another LERF basin or to 200 Area ETF. Additional pumps and piping may be installed to empty the basin as low as possible.
- The basin cover will be cut into pieces and disposed in containers.
- As much as practical of the remaining residue within the basins will be removed and transferred to containers, another LERF basin, or 200 Area ETF. Rinsing may be performed to facilitate removal.
- The pipe risers, transfer pump, HDPE primary liner and bentonite carpet liner will be cut into pieces and disposed in containers.

H.3.4.2 Drainage Layer and Secondary Liner

The following steps will be performed to close each LERF basin drainage layer and secondary liner:

- The drainage gravel, geotextile, and geonet will be cut into pieces, and disposed in containers.
- As much as practical of the remaining residue on the secondary liner will be removed and transferred to containers, another LERF basin or 200 Area ETF. Rinsing may be performed to facilitate removal of residue.
- The HDPE liner portion of the secondary liner will be visually inspected for physical damage. This will provide potential sampling locations to determine if the soil/bentonite below the HDPE liner may be clean closed.
- The leachate pump, pump riser, and HDPE liner portion of the secondary liner will be removed, cut into pieces, and disposed in containers.
- The soil/bentonite portion of the secondary liner will be visually inspected for signs of contamination. This will provide potential sampling locations to determine if the soil/bentonite may be clean closed.

Assessment of contamination beneath the LERF's secondary liner will be performed within each basin by sampling the top surface of the 36-inch thick layer of soil/bentonite. Biased and random location selection will be used to increase the probability of detecting leachate contamination. Some sampling points will be chosen randomly, while others will be chosen where physical damage was noted during the inspection of the secondary HDPE liner and soil/bentonite layer, and in areas where the underlying material porosity and permeability and the hydraulic head would most likely drive any leachate. The leakage rate through the liner would increase toward the bottom of the liner as hydraulic head increases. Any leakage that did occur in the sloped sides could be expected to travel down slope through the geotextile between the primary and secondary liner until reaching the bottom of the liner.

Therefore, the most likely area of contamination would be the soil/bentonite in the leachate sump and at the bottom of the basin. Sampling and disposal objectives will be determined at the time prior to closure activities through the data quality objectives process. The sampling and analysis plan will be prepared following the completion of a data quality objectives process in accordance with EPA/600/R-96/055 (QA/G-4) *Data Quality Objectives Process*, as amended.

The data quality objectives process will be initiated prior to closure on a schedule to ensure timely closure of LERF. The sampling and analysis plan will be submitted to Ecology as part of a permit modification request meeting the requirements of WAC 173-303-830. The sampling and analysis plan will be prepared consistent with EPA/240/B-01/003 (EPA QA/R-5), *EPA Requirements for Quality Assurance Project Plans*, as amended.

Sampling of the soil/bentonite will be performed in accordance with the sampling methods allowed for in WAC 173-303-110(2). Special care will be needed in sampling for volatiles. To aid in ensuring sample integrity, the initial sampling of the soil/bentonite may proceed while the secondary HDPE liner is in the process of being removed.

If no constituents of concern are found above soil closure performance standards (Section H.2.3), no further analysis will be done. If the initial sample analysis indicates liner leakage, additional samples from different depths and locations will be taken to determine the spatial extent of contamination. The soil/bentonite will be removed in the area around the contamination and placed in containers. If contamination is found to extend through the entire depth of the soil/bentonite layer, soil beneath the basin that is contaminated above closure performance standards will also be removed and placed in containers.

H.3.4.3 Tank Systems

The following general steps will be performed to close, each 200 Area ETF tank and ancillary equipment:

- Wastewater and chemical additions to the tank will be isolated or rerouted to a downstream tank.
- Piping and ancillary equipment associated with the tank will be flushed with water and drained to the tank being closed, to another tank, or to containers.
- Wastewater will be removed from the tank and transferred to another tank. Additional pumps and piping may be installed to empty the tank as low as possible.
- All remaining residue at the bottom of the tank will be removed and transferred to another tank or containers. Rinsing may be performed to facilitate removal of residue.
- An initial visual inspection of the tank's interior and exterior surfaces will be performed to determine the type of flushing that will allow the tank to be clean closed, or whether the tank cannot be clean closed.
- For all tanks, except Load-In Station Tanks 59A-TK-109 and 59A-TK-117, the tank's surfaces, piping and ancillary equipment will be cleaned by chemical or physical extraction techniques described in 40 CFR 268.45. Flush solution will be transferred to another tank or containers. All flush solution at the bottom of the tank will be removed before visual inspection.
- Due to severe pitting and corrosion, attainment of a clean debris surface is not practical for Load-In Station Tanks 59A-TK-109 and 59A-TK-117. Consequently, these tanks will be removed and disposed of as dangerous waste. The tank, piping, and ancillary equipment will be inspected visually for compliance with the performance standard in Sections H.2.1 and H.2.2.

Closure will begin with the Load-In Station tanks, surge tank, and other tanks of the main treatment train. The secondary treatment train will operate as long as possible to reduce the volume of flush water requiring disposal. Condensate from the secondary treatment train will be routed to the main treatment train or the verification tanks for storage or treatment.

After rinsing, the tanks will be inspected visually for compliance with the performance standard. Visual inspection might be made remotely using a camera or other device that allows verification of meeting the performance standard.

If any tank surface areas are found not to meet the clean debris surface performance standard, these areas will be decontaminated in-place, or the contaminated portions will be removed, designated, and disposed accordingly. Per 40 CFR 268.45, Table 1 incorporated by reference at WAC 173-303-140, only removal of contaminants from the surface layer is necessary for metal surfaces.

The outside of the tanks also will be inspected for compliance to the performance standard. Any areas found not to meet this performance standard will be decontaminated in-place, or the contaminated portions will be removed, designated, and disposed accordingly.

Before using decontamination solutions on the outside of the tanks, the floor will be inspected for cracks or other openings that could provide a pathway to soil. This inspection will be performed as described in Section H.2.3 in conjunction with mapping of potential through-thickness cracks. Any such cracks will be mapped. The cracks will be sealed before beginning treatment or other engineered containment devices (e.g., portable catch basins, liners) will be used to collect and contain solutions.

Decontamination residues will be collected, designated, and managed as appropriate. If it is not possible to meet the clean closure performance standard, contaminated portions of the tanks could be removed, designated, and disposed of accordingly. The inspections for a clean debris surface will be documented on an inspection record.

H.3.4.4 Internal and External Piping and Ancillary Equipment

The internal piping and ancillary equipment for both LERF and 200 Area ETF, which have contacted dangerous waste will be flushed and drained as part of closure. Any treatment media, such as filters, reverse osmosis membranes, ion exchange resins, will be removed from the ancillary equipment, and disposed of accordingly. Where the contaminated surfaces can be inspected, an inspection will be performed to see if the piping and ancillary equipment meet the clean debris surface standard in 40 CFR 268.45 and can be declared non-dangerous. If it is not possible to meet the clean debris surface standard or the piping or ancillary equipment cannot be inspected, those portions of the piping and ancillary equipment will be removed, designated, and disposed of accordingly.

External piping (transfer lines) associated with LERF and 200 Area ETF consist of below grade and above grade piping. Below grade, piping will be dispositioned at closure consistent with the practices for below grade piping in the 200 Areas at the time of closure consistent with the 200-IS-1 operable unit decisions. Above grade piping will be dispositioned consistent with the provisions for internal piping.

Rinsate from the LERF and 200 Area ETF external piping and LERF internal piping will be processed through 200 Area ETF. Dangerous and/or mixed-waste solutions and materials generated during closure activities, which cannot be treated at 200 Area ETF will be managed in accordance with WAC 173-303-610(5).

H.3.4.5 Concrete

At LERF, the concrete catch basins are located at the northeast corner of each retention basin, where inlet pipes, leachate risers, and transfer pipe risers emerge for the basin. The concrete catch basin is curbed, and coated with a chemical resistant epoxy sealant. The concrete catch basin is sloped so that any leaks or spills from the piping or connections will drain into the basin. At the 200 Area ETF, the coated concrete floor and berm provides secondary containment for all the tanks and process piping.

Closure of concrete at LERF and 200 Area ETF will be performed after the associated tanks, piping, ancillary equipment, and structures have been closed. All concrete will be inspected visually and surveyed before any decontamination. The purpose of the inspection will be twofold: to identify and map any cracks in the concrete that might have allowed contaminants a pathway to the soil below (Section H.2.3), and to identify areas that potentially are contaminated with dangerous waste or dangerous waste residues. The inspection standard will be a clean debris surface as defined in Section H.2.1. The inspection of the concrete for a clean debris surface will be documented on an inspection record. Those areas already meeting the standard can be clean closed as is.

Those potentially contaminated areas will undergo decontamination to meet the clean closure standard of a clean debris surface. The concrete will be washed down; the rinsate collected, designated, and disposed of accordingly. The concrete will be reinspected for a clean debris surface. Concrete surfaces indicated by visual examination, as still being potentially contaminated will have the surface layer removed to a depth of 0.25 inches by scabbing or other approved methods. This will not threaten the environment, even if potential through-thickness cracks had been found during the inspection, because concrete decontamination (scabbing) will not employ liquid solutions that could enter cracks and because scabbing residues will be vacuumed away from cracks as, any residue is generated.

Achievement of a clean debris surface will be documented on an inspection record. Decontamination residues will be collected, designated, and managed as appropriate.

H.3.4.6 Structures

If contaminated with either dangerous or mixed waste constituents, the 200 Area ETF structures will be decontaminated and/or disassembled, if necessary, packaged, and disposed of in accordance with existing land disposal restrictions (WAC 173-303-140).

Closure steps could include the following activities.

- Containerize (as necessary and practicable) and remove any remaining waste.
- Review operating records for spillage incidents and visually inspect storage area surfaces for evidence of contamination or for cracks that could harbor contamination or allow the escape of decontamination solutions. Inspect storage area surfaces for visible evidence of contamination (e.g., discoloration, material degradation, wetness, and odor). If contamination is evident, the affected area(s) will be decontaminated.
- Decontaminate 200 Area ETF walls and floors to minimize the potential for loose contamination and facilitate any required surveys and/or chemical field screening. The structures could be cleaned by water rinse or high-pressure, low-volume steam cleaning coupled with a detergent wash. After decontamination, the walls and floors will be compared to closure performance standards.
- Collect rinsate and manage as dangerous waste for appropriate disposal.
- Secure (lock) personnel entries into building and post doors with appropriate warning signs.

H.3.4.7 Underlying Soils

Clean closure of soil under LERF's secondary liner will be accomplished by demonstrating that the liners and leak detection system kept contaminants from reaching the soil. The secondary liner provided secondary containment for the LERF basins. Unless inspections identify potential leaks, punctures, cracks, or tears indicating containment failure and a subsequent potential for soil contamination from TSD unit operations, the soil will be considered clean closed. However, if inspections identify such leaks, punctures, etc., potential soil contamination will be investigated.

Clean closure of soil under 200 Area ETF will be accomplished by demonstrating that the coated concrete floor kept contaminants from reaching the soil. The coated concrete floor and bermed area provided secondary containment for all the tanks and process piping. Unless inspections identify potential through-thickness cracks indicating containment failure and a subsequent potential for soil contamination from TSD unit operations, the soil will be considered clean closed. However, if inspections identify such cracks and there have been documented spills in the vicinity, potential soil contamination will be investigated.

Where it is possible visually to inspect directly beneath the tanks, a visual inspection will be performed. Where it is not possible visually to inspect beneath the tanks, an evaluation of the tank integrity will be made. The condition of the tank will be evaluated to determine if there was any potential for leakage. If no cracks, severe corrosion, or evidence of leaks is observed, it will be reasoned that mixed or dangerous waste solutions could not have penetrated to the soil directly below the tank.

External piping (transfer lines) between the 242-A Evaporator and LERF and 200 Area ETF are double lined with a leak detection system. If records indicate that no leaks from the primary piping occurred, the soil will be considered clean with respect to RCRA closure.

Where there is evidence that contamination may have leaked into the soil below tanks, concrete, or the soil/bentonite layer at LERF, the contaminated tank, concrete, or soil/bentonite layer will be removed to allow the underlying soil to be sampled to determine the depth of the contamination. Soil that is contaminated above the closure performance standards in Section H.2.3 will be removed, placed in containers, and disposed accordingly.

H.4 Maximum Waste Inventory

The maximum waste inventory for LERF and 200 Area ETF is in Addendum A.

H.5 Closure of Containers, Tanks, and Surface Impoundments

The following sections cover closure of containers, closure of tanks, and closure of surface impoundments.

H.5.1 Closure of Containers

Containers at 200 Area ETF will be used to contain dangerous waste in the event of a spill, unexpected release, or equipment failure. Containers will be used to accumulate nonradioactive dangerous waste and/or mixed wastes. All containers will be emptied and treated prior to closure of 200 Area ETF. Any containers used to contain dangerous and/or mixed waste at the 200 Area ETF that is generated during the closure process and therefore cannot be treated at 200 Area ETF will be designated and shipped to an onsite TSD unit or off-site TSD facility. Containers of dangerous and/or mixed waste will not be left in the 200 Area ETF after closure.

H.5.2 Closure of Tanks

Clean closure of 200 Area ETF will consist of the removal and disposal of all dangerous waste and the decontamination and/or removal and disposal of equipment which does not meet the performance standards in Section H.2, including tanks. The 200 Area ETF was designed to incorporate removable components. This design facilitates closure by allowing complete removal of equipment, which does not meet the performance standards.

H.5.2.1 Load-In Tanks 59A-TK-109 and 59A-TK-117

Tanks 59A-TK-109 and 59A-TK-117 have been isolated from sources of dangerous waste and isolated from sources of dangerous waste because of severe pitting and corrosion. As such, these tanks are not fit for use; and do not meet the criteria for clean closure. Removal of the tanks would cause a disruption in receiving and processing waste from other Hanford liquid waste generators. Therefore, in accordance with WAC 173-303-610(4)(a)(i), closure of Tanks 59A-TK-109 and 59A-TK-117 is extended to the closure of the LERF and 200 Area ETF, at which time the tanks and system components will be concurrently managed as dangerous wastes and will be closed in accordance with this plan. The change in waste streams managed at the 2025-ED Load-In Station, capacity of Load-In Station Tank 59A-TK-1, and the ability to unload tankers directly to the LERF basins has negated the need to replace the capacity of Tanks 59A-TK-109 and 59A-TK-117.

Tank 59A-TK-109 is empty and isolated from service; with the inlet valve (59A-MV-109), and outlet valve (59A-MF-105) locked in the closed position isolating the tank from sources of dangerous waste.

The inlet valve (59A-MV-109) and outlet valve (59A-MV-105) will be removed and replaced with blank flanges to isolate the tanks physically from potential sources of dangerous waste.

Tank 59A-TK-117 is empty and isolated from service; with the inlet valve (59A-MV-117) physically removed and replaced with blank flange, and the outlet valve (59A-MV-113) locked in the closed position isolating the tank from sources of dangerous waste. The outlet valve (59A-MV-113) will be removed and replaced with a blank flange to isolate the tank physically from potential sources of dangerous waste.

The 2025-ED Load-In Station pumps, piping, secondary containment pit, sump, and sump leak detection will remain in service to support the mission of 2025-ED Load-In Station. The Load-In Station tank system (including Tanks 59A-TK-109 and 59A-TK-117) is inspected in accordance with Addendum I, Table I.1.

H.5.3 Closure of Surface Impoundments

At closure, all of LERF that received regulated waste will be closed in accordance with the requirements of this approved closure plan, which are intended to ensure compliance with the requirements of WAC 173-303-650(6)(a)(i). All equipment, structures, and other material associated with closure of LERF will be decontaminated or removed in accordance with WAC 173-303-610(2). All basin waste and decontamination rinsate will be transferred to 200 Area ETF. Sampling and testing will be conducted as described in Section H.3.4.2.

H.6 Schedule for Closure

Closure of LERF and 200 Area ETF has been extended to 2052 to support tank waste processing. The actual year of closure will depend on the time required for current waste to be processed and what role the LERF and 200 Area ETF will play in processing additional waste generated during future activities in the 200 Areas. Other factors affecting the year of closure include changes in operational requirements, lifetime extension upgrades, and unforeseen factors. When a definite closure date is established, notification of closure will be provided in accordance with Permit Condition II.J.3.

The activities required to complete closure are planned to be accomplished within 180 days in accordance with WAC 173-303-610(4)(b). Should a modified schedule be necessary, a revised schedule will be proposed through the permit modification procedure in accordance with WAC 173-303-610(4)(b).

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LIQUID EFFLUENT RETENTION FACILITY (LERF) & 200 AREA EFFLUENT TREATMENT FACILITY (ETF) ADDENDUM I INSPECTION REQUIREMENTS

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number
10/25/2017	8C.2017.3F
08/25/2016	8C.2016.Q2

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ADDENDUM I
INSPECTION REQUIREMENTS

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ADDENDUM I
INSPECTION REQUIREMENTS

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TABLES

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I. INSPECTION REQUIREMENTS

I.1 Inspection Plan

This addendum describes the method and schedule for inspections of the Liquid Effluent Retention Facility (LERF) and 200 Area Effluent Treatment Facility (ETF). The purpose of inspections is to help ensure that situations do not exist that might cause or lead to the release of dangerous and/or mixed waste that could pose a threat to human health and the environment. Abnormal conditions identified by an inspection will be corrected on a schedule that prevents hazards to workers, the public, and the environment.

I.1.1 General Inspection Requirements

The content and frequency of inspections are described in this section. Inspection records are retained in the Hanford Facility Operating Record, LERF and 200 Area ETF file, or other approved locations, in accordance with Permit Condition II.I.1.

In certain areas of the 200 Area ETF, many inspections are performed remotely to maintain as low as reasonably achievable (ALARA) exposure. Monitoring instruments are connected to audible alarms and visual indicators track alarm status. The monitoring system provides trending of selected monitoring data, graphics, and equipment summary displays.

A preventive maintenance recall system is employed to direct preventive maintenance activities at the LERF and 200 Area ETF. Equipment requiring maintenance is checked as indicated by the maintenance history and the manufacturer's recommendations. The preventive maintenance of certain equipment might not be possible if the LERF or the 200 Area ETF is in an operational mode. Thus, the preventive maintenance could be performed slightly earlier or later than planned to minimize impact on operations.

Instrumentation at 200 Area ETF is calibrated regularly to ensure accuracy and reliability. All process control instrumentation is calibrated on a schedule depending on previous calibration experience. An instrument calibration and recall system is employed to manage calibrations.

I.1.1.1 Types of Problems

Key components of the LERF inspection program include the following areas:

- Structural integrity of the basins.
- Catch basin secondary containment system integrity.
- Evidence of release from basins.
- Safety, communications, and emergency equipment.

Key components of the 200 Area ETF inspection program include the following areas:

- Condition of tanks and ancillary piping.
- Condition of containers.
- Condition of the process control equipment.
- Condition of emergency equipment.
- Condition of secondary containment.

Table I.1 and Table I.2 provide a description of LERF and 200 Area ETF items to be inspected.

I.1.1.2 Frequency of Inspections

The frequency of inspections is based on the rate of possible deterioration of equipment and the probability of a threat to human health or the environment.

The LERF and 200 Area ETF is inspected as indicated in Table I.1 and Table I.2.

I.1.2 Specific Process Inspection Requirements

The following sections describe the specific process inspections performed at LERF and 200 Area ETF.

I.1.2.1 Container Inspections

Containers are used at the 200 Area ETF to store solidified secondary waste, such as the powder waste from the thin film dryer and maintenance and operations waste. When containers are being held in container storage areas, the following inspection schedule is maintained:

- Daily visual inspection of container storage area for leaks, spills, accumulated liquids, and open or improperly sealed containers.
- Weekly visual inspection of container labels to ensure labels are not obscured, removed, or otherwise unreadable.
- Weekly visual inspection for deterioration of containers, containment systems, or cracks in protective coating or foundations caused by corrosion, mishandling, or other factors.

Following the inspections, an inspection datasheet is signed and dated by the inspector and supervisor.

I.1.2.2 Tank Inspections

A description of the tank systems and ancillary equipment at the 200 Area ETF is given in Addendum C. Inspections and frequencies are given in Table I.1 and Table I.2. This section includes a brief discussion of the inspections.

I.1.2.2.1 Overfill Protection

Tanks that have the possibility of being overfilled have level instrumentation that alarms before the tanks reach overflow. High tank level alarms annunciate in the 200 Area ETF Control Room, allowing operating personnel to take immediate action to stop the vessels from overfilling. These alarms are monitored continuously in the 200 Area ETF Control Room during solution transfers. When tank level instrumentation is inoperable, the alternate controls discussed in Addendum C, Section C.4.4.2 are followed to prevent tank overfilling.

I.1.2.2.2 Visual Inspections

Visual inspections of tanks and secondary containments are performed to check for leaks, signs of corrosion or damage, and malfunctioning equipment. Inspections are performed on tanks, secondary containment within the 200 Area ETF, surge tank, and verification tank, and associated secondary containment.

I.1.2.2.3 Secondary Containment Leak Detectors

The surge tank and verification tank secondary containment systems have sloped floors that drain solutions to sumps equipped with leak detectors that alarm in the 200 Area ETF Control Room. These alarms are monitored continuously in the 200 Area ETF Control Room during 200 Area ETF processing operations or during waste transfer, and at least daily when processing operations or waste transfers are not occurring. If an alarm is activated, further investigation is performed to determine if the source is a tank leak or other solution (i.e., precipitation).

I.1.2.2.4 Integrity Assessments

The initial integrity assessment was issued in 1995 (Addendum C). Consistent with the recommendations of the integrity assessment, a periodic integrity assessment program was developed for the 200 Area ETF tanks and is discussed in detail in Addendum C, Section C.4.1.5.

I.1.2.2.5 Effluent Treatment Facility Piping

The 200 Area ETF employs an extensive piping system. During inspections at the 200 Area ETF, any aboveground piping is inspected visually for signs of leakage and for general structural integrity.

During the visual inspection, particular attention is paid to valves and fittings for signs of cracking, deformation, and leakage.

I.1.2.3 Surface Impoundments and Condition Assessment

The following describes the surface impoundment inspections performed at LERF.

I.1.2.3.1 Overtopping Control

Under current operating conditions, 2 feet of freeboard is maintained at each LERF basin, which corresponds to an operating level of 22.2 feet, or operating capacity of 7.8 million gallons. Level indicators at each basin are monitored to confirm that this level is not exceeded.

Before an aqueous waste is transferred into a basin, administrative controls are implemented to ensure overtopping will not occur during the transfer. The volume of feed to be transferred is compared to the available volume in the receiving basin. The transfer is not initiated unless there is sufficient volume available in the receiving basin or a cut-off level is established. The transfer into the basin would be stopped when this cut-off level is reached.

The LERF basins also are provided with floating very low-density polyethylene covers that are designed and constructed to prevent overtopping by the introduction of precipitation and dust into the basins. Overtopping and flow control also are discussed in Addendum C.

I.1.2.3.2 Impoundment Contents

The LERF basins are inspected weekly to assess whether the contents are escaping from a basin. Level indicators are inspected weekly to check for unaccountable change in the level of the basins.

I.1.2.3.3 Leak Detection

The leachate detection, collection, and removal system is described in Addendum C. The leachate collection sump pump is activated when the liquid level in the leachate sump reaches a preset level. A flow meter/totalizer measures the amount of leachate removed. In addition, the timer on the leachate pump tracks the cumulative pump run time. The leak rate through the primary liner can be determined using one of two methods:

1) Measured as the leachate flow meter/totalizer readings (flow meters/totalizers are located on the outflow line from the collection sumps in the bottom of the LERF basins) or
2) Calculated using the pump operating time readings multiplied by the pump flow rate (the pump runs at a constant flow rate).

Calculations using either method are sufficient for compliance. If either the flow meter/ totalizer or pump operating time system is not functioning, this is identified as an abnormal condition (see Section I.1).

The LERF employs a double walled transfer piping between 242-A Evaporator and LERF and between LERF and 200 Area ETF. The WAC 173-303-650 regulations do not require a discussion of piping for surface impoundments. However, for the purposes of comprehensive coverage of the LERF, inspections and integrity assessments are performed on the piping system. Aqueous waste (e.g., process condensate) is transferred from the 242-A Evaporator to the LERF via a buried pipeline. Likewise, aqueous waste is transferred to the 200 Area ETF via buried pipelines. At the LERF dikes, aboveground piping serves to transfer waste from one basin to another.

The buried pipelines normally are continuously monitored during transfers by a leak detection system (Addendum C). Leak detection system alarms annunciate to the 200 Area ETF Control Room, which is monitored continuously during waste transfers and daily when no waste is transferring. As an alternative to continuous leak detection, the transfer lines can be inspected daily during transfers by opening the secondary containment drain lines at the LERF catch basins (for 242-A Evaporator transfers to LERF) and the surge tank (for LERF transfers to 200 Area ETF) to inspect for leakage. During the routine inspections at LERF, the aboveground piping system is inspected for signs of leakage and for general structural integrity. During the visual inspection, particular attention is paid to valves and fittings for signs of cracking, deformation, and leakage.

I.1.2.3.4 Dike Erosion

The LERF basins and dikes are visually inspected weekly and after significant precipitation events for run-on, run-off, cover integrity, erosion problems, or other signs of deterioration in the dikes from precipitation, wind, burrowing mammals, or vegetation.

I.1.2.3.5 Structural Integrity

A written certification attesting to the structural integrity of the basin dikes, signed by a qualified, registered professional engineer, is provided in Addendum C.

I.1.2.3.6 Container Inspection

Normal operation of the LERF does not involve the storage of dangerous waste in containers. Therefore, the inspection requirements of this section normally are not applicable to the LERF. Any containerized dangerous waste generated at LERF will be brought to the 200 Area ETF and managed in accordance with WAC 173-303-630 and is discussed in Addendum C.

I.1.3 Inspection Log

Observations made and deficiencies noted during an inspection are recorded on inspection log sheets (also called turnover sheets). On completion, the log sheet includes the inspector's printed name, signature, date, and time; the log sheet is submitted for review and approval by LERF and 200 Area ETF management or their designee, as required by operating procedures. Once approved, the log sheet is kept in the Hanford Facility Operating Record, LERF and 200 Area ETF files. Inspection records are retained in the Hanford Facility Operating Record, LERF and 200 Area ETF files, or other approved locations, in accordance with Permit Condition II.I.1. The inspection records are used to help determine any necessary corrective actions. Problems identified during the inspections are prioritized and addressed in a timely fashion to mitigate health risks to workers, maintain integrity of the TSD units, and prevent hazards to public health and the environment.

If while performing an inspection, a leak or spill is discovered, facility operations responds per the emergency response procedures action is taken to stop the leak and determine the cause. The waste is removed from the secondary containment in a timely manner that prevents harm to human health and the environment.

I.1.4 Storage of Ignitable or Reactive Wastes

The LERF could receive an aqueous waste that is designated reactive or ignitable. Any aqueous waste exhibiting these characteristics is managed (e.g., through flow equalization in LERF) such that the waste no longer exhibits the reactive or ignitable characteristics.

Though unlikely, the 200 Area ETF secondary wastes might have the characteristics of being reactive or ignitable. A qualified inspector performs annual fire inspections of the 200 Area ETF using a checklist developed specifically for facilities that handle dangerous and/or mixed waste.

1 **Table I.1. Visual Inspection Schedule for the LERF and 200 Area ETF**

Item	Inspection	Frequency
2025-ED Load-In Station		
Load-In Station tank system	Inspect area for leaks. Note any unusual noises or vibration from the system pumps. Inspect secondary containment system for signs of deterioration.	Daily
Main Treatment Train		
Surge tank system	Inspect area for leaks. Note any unusual noises or vibration from the system pumps. Inspect secondary containment system for signs of deterioration.	Daily
Rough filter	Inspect for leaks.	Daily
Ultraviolet oxidation system	Inspect module for leaks Inspect peroxide storage tank, ancillary equipment for leaks.	Daily
pH adjustment tank	Inspect tank and ancillary equipment for leaks	Daily
H_2O_2 decomposer	Inspect tank and ancillary equipment for leaks	Daily
Fine filter	Inspect module for leaks	Daily
Degasification system	Inspect module for leaks. Note any unusual noises or vibration from the degasification blower.	Daily
Reverse osmosis system	Inspect tanks and ancillary equipment for leaks. Note any unusual noises or vibration from the system pumps.	Daily
Polishers	Inspect tanks and ancillary equipment for leaks.	Daily
Effluent pH adjustment tank	Inspect tank and ancillary equipment for leaks.	Daily
Verification tanks	Inspect tanks and ancillary equipment for leaks. Note any unusual noises or vibration from the system pumps. Inspect secondary containment system for signs of deterioration.	Daily
Secondary Treatment Train		
Secondary waste receiving tank	Inspect tank and ancillary equipment for leaks	Daily
200 Area ETF evaporator	Inspect tank and equipment for leaks. Note any unusual noises or vibration from the system pumps or compressor.	Daily
Concentrate tank	Inspect tank and ancillary equipment for leaks.	Daily
Thin Film Dryer Room	Inspect piping and ancillary equipment for spills, leaks, and accumulated liquids (viewed through camera). Note any unusual noises or vibration from the system pumps or blower.	Daily[1]
Container handling	Inspect area for spills, leaks, accumulated liquids.	Daily
Container handling	Inspect for deterioration of containers and secondary containment, including corrosion and cracks in secondary containment foundation and coating. Inspect container labels to ensure that they are readable.	Weekly
Support Systems		
Vessel ventilation system	Inspect filters (HEPA and pre-filters), check vessel off gas pressures, system flow, and discharge temperatures.	Daily
Sump tank system	Inspect sump trenches for unexpected liquids, which indicate spills or leaks from process equipment.	Daily

[1]If the camera system is inoperable, daily visual inspections will be performed or the Thin Film Dryer will be emptied and isolated as described in Addendum C, Section C.4.4.2, to prevent waste additions that could result in undetected leaks or spills in the Thin Film Dryer Room.

Item	Inspection	Frequency
Safety Systems		
Eye wash stations	Check status; check for adequate pressure	Monthly
Safety showers	Check status; check for adequate pressure	Monthly
Emergency Systems		
Fire extinguishers	Check for adequate charge.	Monthly
Emergency lighting	Test operability.	Monthly
Processing Area		
Uninterruptible power supply	Check output voltage and visually inspect battery pack for corrosion and leakage. Check indicator lights for fault conditions.	Annually
LERF (Surface Impoundment)		
LERF basins and dikes	Check the overtopping controls and integrity of the basins and dikes	Weekly
LERF contents	Check basin level indicators for unaccountable changes in the level of the basins	Weekly
Leak Detections	Determine the leak rate per wetted surface area	Weekly
LERF basins and dikes	Check for run-on, run-off, cover integrity, erosion problems, and other signs of deterioration	Weekly & After significant precipitation events
Ignitable and Reactive		
Ignitable and reactive waste	Storage in compliance with Hanford Site fire protection standards and WAC 173-303-630(8)	Annually[2]
Container Storage Areas Other Than Secondary Treatment Train		
Container Storage	Container labels to ensure labels are not obscured, removed, or otherwise unreadable	Weekly
	Deterioration of containers, containment systems, or cracks in protective coating or foundations caused by corrosion, mishandling, or other factors	Weekly
	Leaks, spills, accumulated liquids, and open or improperly sealed containers	Daily

HEPA – High efficiency particulate air

[2]When waste management activities occur

I.1.5 Instrumentation Monitoring

Continuous monitoring applies to the electronic monitoring performed in the 200 Area ETF Control Room for this instrumentation during 200 Area ETF processing operations and/or 2025-E Load-In Station transfers. Data from alarms, leak detectors, and level transmitters are monitored daily in the 200 Area ETF Control Room when waste transfers are not occurring (see C.2.5.1). In cases where this instrumentation is out of service (e.g., calibration, power failures, or maintenance) daily visual inspections will be performed in accordance with WAC 173-303-640, using the alternate methods discussed in Addendum C, Section C.1 for leak detection, Section C.4.3.1.2 for level inspection, and Section C.4.4.2 for overfill prevention will be followed.

In the event the electronic leak detectors or level indicators for Sump Tank 1 or Sump Tank 2 are out of service, daily visual inspections will be performed each operating day (WAC-173-303-640).

Inspections pertaining to instrumentation monitoring is provided in Table I.2.

Table I.2. Inspection Plan for Instrumentation Monitoring

Item	Inspection	Frequency
2025-ED Load-In Station		
Level alarm LSH-59A-003	Monitor liquid level in Load-In Tanks TK-1 to prevent overflow	Continuously
Leak detector	Monitor for leakage in the Load-In Station tank pit sump	Continuously
Main Treatment Train		
Leak detector LAH-20B009	Monitor for leakage in the surge tank drainage sump	Continuously
Level alarm LAH-60A013	Monitor surge tank level to prevent overflow	Continuously
Level alarm LAHL-60C-111	Monitor liquid levels in the pH adjustment tank to prevent overflow	Continuously
Level alarm LAHL-60F-101	Monitor liquid levels in the first RO feed tank to prevent overflow	Continuously
Level alarm LAHL-60F-201	Monitor liquid levels in the second RO feed tank to prevent overflow	Continuously
Level alarms LAHL-60C-211	Monitor liquid levels in the effluent pH adjustment tank to prevent overflow	Continuously
Level transmitter LAHX-60H001A/B/C	Monitor liquid level in verification tanks to prevent overflow	Continuously
Leak detector LAH-20B010	Monitor for leakage in the verification tank drainage sump	Continuously
Secondary Treatment Train		
Level alarm LAHL-60I-001A/B	Monitor liquid levels in secondary waste receiver tanks A and B to prevent overflow.	Continuously
Level alarm LAHL-60J-001A/B	Monitor liquid levels in concentrate tanks A and B to prevent overflow.	Continuously
Level alarm LAHL-60I-107	Monitor liquid levels in the evaporator tank to prevent overflow.	Continuously
Level alarm LAHL-60J-036	Monitor liquid levels in the spray condenser tank to prevent overflow.	Continuously
Level alarm LAHL-60I-108	Monitor liquid levels in the distillate flash tank to prevent overflow.	Continuously
Level alarm LAH-60I-119	Monitor liquid levels in the entrainment separator tank to prevent overflow.	Continuously
Level transmitter LAH-20B001	Monitor liquid level in Sump Tank 1 to prevent overflow.	Continuously
Level transmitter LAH-20B002	Monitor liquid level in Sumo Tank 2 to prevent overflow.	Continuously
Leak detector LAH-20B003	Monitor for leakage to Sump No. 1.	Continuously
Leak detector LAH-20B005	Monitor for leakage to Sump No. 2.	Continuously

Item	Inspection	Frequency
Leak detector	Monitor for leakage from pipeline between 200 Area ETF and 2025-ED Load-In Station.	Continuously
Leak detector	Monitor for leakage from pipeline between 200 Area ETF and LERF.	Continuously
Leak detector	Monitor for leakage from pipeline between LERF and the 242-A Evaporator.	Continuously